o 15.838 Class B computing device: information to user.

This equipment generates and uses radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instructions, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measure:

Reorient the receiving antenna

Relocate the computer with respect to the receiver

Move the computer away from the receiver

Plug the computer into a different outlet so that computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful:

"How to Identify and Resolve Radio-TV Interference Problems".

This booklet is available from the U.S. Government Printing Office, Washington, DC 20402, Stock No. 004-000-00345-4.

Warning-When connecting this device to your computer,
shielded interface cables must be used.

MFJ ENTERPRISES, INC.

Model MFJ-1270C/1274C

Packet Radio Controller
Revision 10

SYSTEM MANUAL

Fourth Edition

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INTRODUCTION

Thank you for purchasing the MFJ TNC Packet Data controller.

The MFJ TNC interfaces your radio with any personal computer that has an RS-232 or TTL level Serial Port and a terminal program. While most communications programs will work, MFJ recommends the use of MFJ Starter Pack for those who have IBM or compatible, Macintosh, Amiga or Commodore C64/128 computers. With an IBM or compatible computer, the MFJ Multicom terminal program gives you added feature like VGA packet picture transfer (IBM & compatible version) that a standard terminal program just can not offer.

This compact versatile controller employs the **genuine** TAPR TNC 2 AX.25 protocol packet firmware. Special firmware like ROSE, NETROM, TheNet are compatible with the MFJ TNC.

In addition, the advanced new DCD circuit in the MFJ TNC has been optimized for HF packet. It can be adjusted to ignore background noise while still being able to respond to a valid data carrier. The new "packet collision prevention" features -- Prioritized Acknowledgments and Slottime are installed. This new technology helps prevent many packet collisions inherent in the current packet protocol.

The MFJ TNC offers the most versatile mailbox available when compared to the mailbox in other controllers. This mailbox allows dedicated mailbox callsign so that the mailbox stays on while you operate packet. Other features like auto forward or reverse forward mail to and from other BBS, remote sysop access, sysop paging, mailbox ctext, chat mode and a "has mail" LED indicator. The MFJ TNC has an 8K bytes memory mailbox. Mailbox memory is user expandable to 32K, 128K or 512K by simply replacing the mailbox memory IC.

If you purchased the MFJ-1274C, you also get MFJ's 20- segment, 10 Hz Precision Tuning Indicator that makes tuning simple for HF Packet.

The EPROM containing the MFJ TNC firmware is 256K bits. It is expandable to 512K bit or 1 Megabits giving the MFJ TNC a lot of room to grow in.

A speaker jack lets you plug in a speaker and monitor both transmit and receive audio. Speaker output also provides packet connect signal alarm.

A 20-pin header provided for the MFJ TNC to operate packet at 2400 or 9600 baud packet by simply pluging in an optional modem board. The MFJ-1270CT and the MFJ-1274CT already has a 2400 modem installed. If your MFJ TNC does not have the 2400 modem installed, it can be purchased separately (MFJ-2400) and installed by you. With the 2400 modem installed, your MFJ TNC can operate 300, 1200 and 2400 packet. You may also purchased the MFJ-9600 modem board that allows the MFJ TNC to operate at 9600 baud packet.

Items supplied with MFJ TNC package

1. One MFJ TNC Packet controller.
2. One AC adapter power supply for 110V AC. 240V AC adapter supplied for MFJ-1270CX or MFJ-1274CX (export model for country which operate on 220-240V AC).
3. One open end radio port cable with 5-pin DIN male connectors.
4. One 8-pin connector for the TTL port.
5. One TNC system Instruction Manual.
6. One TNC Fast-Start Manual.

MFJ also has accessory items available for the MFJ TNC. A list of these items follows on the next page.

Optional items available for the MFJ TNC

Model No	Description
MFJ-1289	Advanced Starter pack for IBM & compatibles
MFJ-1282	Starter pack for Commodore C64/128
MFJ-1287	Starter pack for Macintosh
MFJ-1290	Starter pack for Amiga
MFJ-1272B	MFJ TNC to Microphone switch box
MFJ-5024	Radio connecting cable for Icom/Yaesu/RS HTs
MFJ-5026	Radio connecting cable for Kenwood HTs
MFJ-5080	Radio connecting cable for Yaesu 8-pin radio
MFJ-5084	Radio connecting cable for ICOM 8-pin radio
MFJ-5086	Radio connecting cable for Kenwood 8-pin radio
MFJ-280	Monitor speaker for transmit/receiver audio
MFJ-40E	Packet encryption EPROM
MFJ-43	TNC Real time clock, keeps your TNC on-time
MFJ-45A	32K RAM IC for additional mailbox memory
MFJ-45B	128K RAM IC for additional mailbox memory
MFJ-45C	512K RAM IC for additonal mailbox memory
MFJ-2400	2400 bps internal modem for packet
MFJ-9600	9600 baud internal modem for packet

The above items are available from MFJ dealers or directly from MFJ Enterprises, Inc.

COMPUTER INTERFACING

You are now ready to attach your MFJ TNC to your station computer or terminal. Throughout this manual we will use the term "computer" to refer to the computer or terminal you use to communicate with your MFJ TNC .

The MFJ TNC communicates with your computer through a serial port using signals corresponding to a standard called RS-232C. Why an RS-232C interface? Nearly every computer in production today either incorporates an RS-232C style serial port as a standard feature, or has one available as an optional accessory, either from the computer manufacturer or from a manufacturer of computer accessories. In addition to the RS-232C port, the MFJ TNC has a built- in TTL port to allow interfacing with computers which need TTL signals such as the Commodore C-64, C-128 or the VIC-20.
Computer program\, see Terminal program

In order to use the MFJ TNC with your computer, the computer must have an RS-232C serial port, or a TTL serial port and a program to support the serial or TTL port. The program will typically be called a modem, terminal emulator, or communications program.

Since there are so many computers on the market today, it is impractical for this chapter to provide detailed instructions for each computer. Detailed information is given for some of the popular models available in the United States. Also provided is general computer interfacing information.

MFJ Terminal Software Starter Packs

MFJ Enterprises, Inc. offers a Starter Pack for some of the most popular computers. These Starter Packs contain a terminal program and a cable for connecting the MFJ TNC to your computer. The Starter Packs available are listed below and also on the following page:

MFJ-1282:Commodore VIC-20, C64, C128 on 5-1/4" diskette.

MFJ-1283: Commodore VIC-20, C64 on tape.

MFJ-1284: IBM PC & compatibles on 5-1/4" diskette.
(Supports 2-level FAX)

MFJ-1284M: IBM PC & compatibles on 3-1/2" diskette.
(Supports 2-level FAX)

MFJ-1287B: Macintosh, on 3-1/2" diskette.
(Supports 2-level FAX)

MFJ-1290: Amiga on 3-1/2" diskette.
(Supports 2-level FAX)

Computer Interfacing with MFJ Starter Packs

If you are using one of the MFJ Starter Packs, you should use the cable provided to connect the MFJ TNC and your computer. Follow the instruction manual provided with the Starter Pack to operate the terminal program and to connect the MFJ TNC to your computer. After connecting the MFJ TNC to your computer you can then proceed to the "Computer Baud Rate" section in this chapter to continue installing the MFJ TNC .

Computer Interface without MFJ Starter Pack

If you are **not** using a MFJ Starter Packs you should follow the instruction in this chapter for computer interfacing.

Serial Port Signals

The serial port connector on your MFJ TNC is on the rear panel and is marked "SERIAL." There are several signals available at this connector. You won't need all of them for standard normal operation. For some special applications, such as binary file transfers or some Bulletin Board operations, you may want to use more of them. In that case, see **MFJ TNC Serial Port Pin Functions** in this chapter.

The pins on the serial port connector of the MFJ TNC that must be connected are shown in Table 2-1. Note that the MFJ TNC connects to a computer exactly as if the MFJ TNC were a standard RS-232C modem. If you have successfully used your computer with a telephone modem, hook it up to the MFJ TNC in the same way. Use whatever program you ordinarily use to communicate with the modem.

The basic serial port signals reauired by the TNC for normal operation are listed below in Table 2-1.

Pin	Signal Name	Description
2	Transmit Data	Serial data **from** your computer **to** the MFJ TNC
3	Receive Data	Serial data **from** the MFJ TNC **to** your computer
7	Signal Ground	The common ground for both data lines.

Table 2-1. Serial port signals required by MFJ TNC .

If your computer is listed below in Table 2-2, refer to the specific information in the following sections to connect your MFJ TNC to your computer.

Manufacturer	Model
Apple	Macintosh (tm)
	Apple II,II+,IIe,II-gs(tm)
Commodore	VIC-20 (tm)
	C-64 (tm)
	C-128 (tm)
IBM	PCjr, PC-XT, PC-AT, 386/486
	most PC compatibles
Radio Shack	Color Computer (tm)
	PC Compatiables
Amiga	500, 3000
NEC	8201

Table 2-2. Computers with specific serial interfacing instructions.

Many computers require a serial port adapter card. These cards incorporate the circuitry necessary to add an RS-232C port to the computer. Some popular models in this category are the Apple II series, the IBM Personal Computer, many Radio Shack computers, and the Sanyo MBC-55X series. If you have one of these computers with an "add-in" serial port, or if you have another computer we haven't mentioned, you should skip to one of the sections on "other computers." If your computer has a 25-pin RS-232C serial port, refer to the

section on Other Computers with 25-pin RS-232C Ports. Otherwise refer to the section Other Computers with Nonstandard Serial Ports.
Some computers have no serial port and no adapter is commercially available. Such computers are not suitable for use with the MFJ TNC.

Computers with Specific Serial Interfaces

Apple Macintosh

The Macintosh serial port is an RS-422 compatible port, but it will work fine with the RS-232C serial port on your MFJ TNC .

MFJ Enterprises, Inc. offers an optional Starter Pack for the Macintosh. It can be purchased from MFJ Enterprises, Inc. or any MFJ dealer. The Starter Pack includes an interface cable for connecting the MFJ TNC to the Macintosh and a terminal program. The Starter Pack for Macintosh is MFJ-1287. If you wish to use your own cable, you will need a cable wired as shown in Fig. 2-1.

Macintosh	MFJ TNC	Macintosh	MFJ TNC
8 pin	DB-25P	DB-9P	DB-25P
1 (HSKO)	4	1	1
2 (HSKI)	5	5	2
3 (TXD-)	2	9	3
4 (GND)	7	3	7
5 (RXD-)	3	7	8
6 (TXD+)	N/C	6	4
7 (GPi)	8		
8 (RXD+)	7		
Shield	1		

Macintosh To MFJ TNC Cable Wiring

Fig. 2-1. Serial port wiring for Apple Macintosh.

Note that pin 1 of the DP-9P connector is not connected inside the Macintosh or the MFJ TNC . If you use a shielded serial cable, which we recommend, connect both pin 1s to the shield and connect pin 1 of the MFJ TNC serial connector to

digital ground on the MFJ TNC circuit board. A printed circuit board pad is provided for this purpose near pin 1 of the serial connector.

Commodore C64, C128 and VIC-20

The MFJ TNC has a built-in TTL-level port for interfacing with the Commodore C64, C128 or the VIC-20 computers. You do not need a RS-232C converter to interface with the MFJ TNC.
An optional Starter Pack for the C-64, C-128 or the VIC-20 can be purchased from MFJ Enterprises, Inc. or from any MFJ dealer. The Starter Pack includes an interface cable from the MFJ TNC TTL port to the user I/O port on the Commodore computer. A terminal program is also included. To order, specify MFJ-1282 for software on disk or MFJ-1283 for software on tape.

If you wish to construct your own cable, the information is as follows:

MFJ TNC J-5 Pin#	Mnemonic	Name	C-64/128*, VIC-20 Pin#
1	RXD	Receive Data	B,C
2	DCD	Data Carrier Detected	H
3	GND	Ground(Frame & Signal)	N
4	RTS	Ready To Send	E
5	TXD	Transmit Data	M
6	DSR	Data Set Ready	L
7	CTS	Clear To Send	K

Fig. 2-2A TTL port wiring for VIC-20, C64 and C128

*C-128 is used in the C-64 mode for these connections.
**Pin E is not needed when using terminal program referred to in this chapter for the Commodore computers.

The pin connections for the TTL port (J-5) are numbered from left to right as you look at the back of the MFJ TNC . All of these connections are not necessarily used by your terminal program. The MFJ TNC needs RXD, TXD and GND connected. Programs which utilize file transfer and printer routines will probably use RTS and CTS as well. Consult your software documentation.

IBM PCjr

The PCjr uses standard RS-232C voltage levels for its serial interface; however, the connector used is non-standard and not readily available from electronic supply dealers. Pinout information for this connector is given in the **IBM PCjr Technical Reference Manual.**

IBM dealers sell the "IBM PCjr Adapter Cable for Serial Devices" for converting the connector on PCjr to a standard RS-232C terminal connector. This cable attaches directly between the MFJ TNC and the PCjr. It is only about 3 inches long, however, so you may want to obtain a male-to- female RS-232C extension cable, which should be readily available.

Radio Shack Color Computer

The Color Computer series (except for the Micro Color Computer) uses a 4-pin DIN-style connector for its serial interface. Wire a cable as shown in Fig. 2-2 to interface your MFJ TNC to a Color Computer. All necessary parts should be available from Radio Shack dealers.

Color Computer	DB-25P
4	2
2	3
3	7

Fig. 2-2
Serial port wiring for Radio Shack

Radio Shack Model 100/102 and NEC 8201

These computers have built-in standard RS-232C serial ports that are compatible with the MFJ TNC . You will need a standard male-to-male RS-232C extension cable to connect the computer to the MFJ TNC .

IBM PC/XT/AT/386/486 and compatibles Computer

If your computer is a IBM or compatible, you should have a serial port with standard DB-25 or DB-9 pin connector. You may used a standard IBM **serial modem cable** with the correct gender on each end of the cable.

MFJ Enterprises, Inc. offers optional Starter Pack (MFJ- 1284) for the IBM or compatible computers. The Starter Pack is supplied with the computer connecting cable (DB-25 male to DB-25 female) for connecting your MFJ TNC For other computers with a 25-pin RS-232C port, you should consult your computer manual or accessory manual to see which pins it uses to send and receive data on, as well as which pin is used for signal common. Follow the computer manufacturer's recommendations for connecting the serial port to a modem. You may also find the technical information in this section useful.

Your MFJ TNC is configured as **D**ata **C**ommunications **E**quipment (DCE), the technical term for an RS-232C modem. Most computers are configured as **D**ata **T**erminal **E**quipment (DTE). If this is the case for your computer, you will probably be able to simply wire pin 2 of the MFJ TNC connector to pin 2 of your computer's RS-232C port, pin 3 to pin 3 and pin 7 to pin 7. You can provide these connections with a standard 3- wire male-to-female or male-to-male RS-232C extension cable, depending on whether your computer has a DB25S or DB25P connector.

If your computer is configured as DCE, you will have to wire pin 2 of your MFJ TNC to pin 3 of the computer connector, and pin 2 of the computer connector to pin 3 of your MFJ TNC . Pin 7 of the computer connector will still connect to pin 7 of your MFJ TNC serial port. Some computers may require that pin 5 of the computer serial port connector be connected to an appropriate signal. Others may require connections for pin 8 and pin 20. You can use the computer's output signals on pins 4 and 6 as shown in Fig. 2-3.

MFJ TNC RS-232c	**Computer**
2	2
3	3
7	7
	4
	5
	6
	8

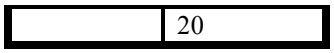


Fig. 2-3. Serial port wiring with jumpers for auxiliary signals.

Other Computers with Non-standard Serial Ports

Computers with non-standard serial ports must meet the following conditions.

First, the signal levels should be RS-232C compatible. The MFJ TNC requires that the voltage levels sent from the computer be greater than about +3 volts in one state and less than about +1 volt in the other state.

Second, the polarity of the signals must conform to the RS-232C standard. This means that the low voltage state must correspond to a logical "1" and the high voltage state to a logical "0".

Third, the computer must be able to correctly receive a signal which meets the RS-232C specification. The MFJ TNC supplies signals that meet this specification.

Make or buy a cable that provides the following connections. The computer serial port common pin must be tied to the MFJ TNC serial port connector pin 7. The data line that sends data from the computer must be tied to the MFJ TNC connector pin 2. The pin on which your computer receives data on must be tied to the MFJ TNC connector pin 3.

If your computer requires any other signals, you must arrange to provide them. The documentation provided with your computer or its accessory serial port should clarify any special requirements of your port.

Terminal Software Requirements

Any software package that enables your computer to act as an ASCII terminal with an ordinary telephone modem should work with your MFJ TNC. If you have a program that you have used successfully with a telephone modem and that you are familiar with, use that program to communicate with your MFJ TNC.

If you are using a terminal program provided by the MFJ Starter Pack, proceed to the "Computer Baud Rate" section in this chapter. Follow the instruction provided by the program.

If you are not using a MFJ terminal program, then proceed with the instruction for your type of computer.
Note: Some terminal programs (such as the Apple II+ Super Serial Card) requires DCD to be asserted before they receive any characters. If this is the

case, place a jumper across pin 1 and 2 of JMP 1. The DCD LED on the front panel will function normally indicating received packets.

Apple Macintosh

The MFJ Starter Pack for the Macintosh (MFJ-1287) includes a terminal program and a cable to connect the MFJ TNC to the Macintosh. If you should want to use a terminal program such as MacTerm set the options according to Table 2-3.

Compatibility	Terminal
1200 baud	VT100
7 bits/character	ANSI
even parity	UNDERLINE
Handshake Xon/Xoff	US
modem connection	80 Columns
"telephone" port	ON LINE AUTOREPEAT

Table 2-3. MacTerm option settings for operation with MFJ TNC

Apple II, II+, IIe, IIc

For the Apple II family of computers with Apple or third- party serial interface cards, you may use ASCII Express Pro, Hayes Smartcom IIe and DataCapture 4.0 for the MFJ TNC . There are others which may be compatible with the MFJ TNC , but have not been tested.

Commodore C64, C128 and VIC-20

The optional Starter Pack for the C-64, C-128 and VIC-20 can be purchased from MFJ Enterprises, Inc. or from any MFJ dealer. Starter Pack includes an interface cable from the MFJ TNC TTL port to the user I/O port on the commodore computer. A terminal program is also included. To order, specify MFJ-1282 for software on disk or MFJ-1283 for software on tape.

If you do not have the MFJ Starter Pack then you may use the BASIC communications program is given in the **Programmer's Reference Guide**

published by Commodore. Use the program listing for "true ASCII," as these computers use a modified ASCII format internally. You will probably want to run your MFJ TNC at 300 baud on the serial port with these computers.

NOTE: When using the above program, you must first use the "COMMODORE" key to shift to lower case before using this program. Also line 200 should read **For J=0 to 64:T%(J)=J:NEXT.**

When making the connecting cable from TTL port of the MFJ TNC to the I/O port of the Commodore computer you may use the wiring information given on page 2-3 in this chapter. However, do not use pin E connection for this program.

IBM PCjr

The IBM PCjr has a built-in terminal program in the BASIC cartridge. Start this program by typing **TERM**. Refer to your PCjr BASIC manual for details on this program. For best results with PCjr, do not run the MFJ TNC serial port faster than 1200 baud.

IBM PC and Compatible Computers

The optional Starter Pack, MFJ-1284) for the IBM PC and compatibles computers can be purchased from MFJ Enterprises, Inc. or from any MFJ dealer. These Starter Packs include a graphics terminal program, and a connecting cable for connecting the MFJ TNC to your computer. MFJ-1284 program allows you to receive 2-level FAX display on the screen. It will also store the pictures on disk for later viewing.

You may also use many commercial, "shareware" and public- domain terminal programs for the IBM PC and compatibles computers. Special program written for packet radio and packet bulletin board service can also be used with the MFJ TNC . Note that these type of programs will not support printing of graphics to the computer screen.

Radio Shack Color Computer

There are several terminal programs available for the Color Computer. You will probably want to use a commercial program (rather than writing your own) since the Color Computer has a "software UART" that is difficult to program in BASIC.

Some of the terminal programs available are COLORCOM 64, AUTOTERM and RICKEYTERM (for Coco III). Others are WIZ and XTERM for OS-9.

Radio Shack Model 100/102 and NEC 8201

These computers have built-in terminal programs in ROM. Consult your computer's documentation for instructions in their use.

MFJ TNC Serial Port Pin Functions

This section describes the pins used on the MFJ TNC RS-232C serial port connector. It is intended for users with special applications requiring hardware handshaking. This information should not be needed by most users.

Pin #	Mnemonic	Name
1	FG	Frame Ground
2	TXD	Transmit Data
3	RXD	Receive Data
4	RTS	Request To Send
5	CTS	Clear To Send
6	DSR	Data Set Ready
7	SG	Signal Ground
8	DCD	Data Carrier Detect
9		+ 12V unregulated reference
10		- 12V unregulated reference

Table 2-4. RS-232C Pin Designations

Frame Ground is provided for attachment to the chassis of the MFJ TNC and the chassis of the attached device (computer or terminal). This pin is brought out to a feedthrough on the MFJ TNC PC board near pin 1 of the serial connector. It is not electrically connected anywhere else on the MFJ TNC circuit board.

Transmit Data is an input line to the MFJ TNC on which the attached device sends data.

Receive Data is an output line from the MFJ TNC on which the attached device receives data.

Request To Send is an input line to the MFJ TNC which the attached device requesting clearance to transmit.

Clear To Send is an output from the MFJ TNC signaling the attached device to send or refrain from sending data to the MFJ TNC . This line is used for hardware flow control.

Data Set Ready is an output from the MFJ TNC telling the attached device that the MFJ TNC is operational.

Signal Ground is the common, or return, path for all signals between the MFJ TNC and the attached device.

Data Carrier Detect is an output from the MFJ TNC . As normally configured, DCD reflects the status of the CON LED: It is true when an AX.25 connection exists between your MFJ TNC and another station; it is false when no connection exists. This configuration is useful when the MFJ TNC is used with a telephone style Bulletin Board system, since the AX.25 connection, analogous to a modem signal on the telephone, indicates the presence of a user. Shorting pin 1 and 2 of JMP1 on the MFJ TNC board will cause this output to always be true.

Computer Baud Rate

Turn off the power to your computer and to your TNC. Connect the computer and TNC with a properly configured serial cable. Set the DIP switch on the rear panel of the TNC to the desired baud rate as shown in Table 2-4. The power **must** be OFF when these switches are set.

NOTE: The serial port baud rate used between the TNC and the computer has no relationship to the baud rate used over the radio. The serial port baud rate you set on your TNC must match the baud rate used by your computer serial port.

Turn on your computer and start the terminal program. Follow the directions for the program you are using to match the computer's baud rate with that selected on the TNC, and to set other options. Set your computer's port options to 7 bits even parity and select either 1 or 2 stop bits.

Turn on your TNC. You should see a sign-on message, which should be a readable text message, printed on your computer screen. This demonstrates the ability of your computer to accept data from your TNC. If you see nothing, switch off your TNC for a few seconds, then on again. If you still see nothing, verify your wiring and restart your terminal program. If you see gibberish on your screen you should verify that you have set the same baud rate for the TNC and the computer.

Verifying Serial Port Operation

Now that you have a terminal program and the hook-up cable for connecting the MFJ TNC to your computer, you are ready to verify that MFJ TNC will communicate with your computer.

1. Turn on your computer. Load and run the terminal program.

2. Set the parameter of the terminal program as follow:

    word length: 8 bits
    duplex: full
    parity: none
    stop bit: 1
    baud rate: select on of the following:
    300, 1200, 2400, 4800, 9600, 19,200

3. Locate the DIP switch in the back panel of the TNC. Set the Dip switch as according to Table 2-4 follows:

Table 2-4. DIP switch settings for computer serial port baud rates.

Baud Rate	Dip Switch				
	1	**2**	**3**	**4**	**5**
300*	**ON**	OFF	OFF	OFF	OFF
1200	OFF	**ON**	OFF	OFF	OFF
2400	OFF	OFF	**ON**	OFF	OFF
4800	OFF	OFF	OFF	**ON**	OFF
9600	OFF	OFF	OFF	OFF	**ON**
19200*	**ON**	OFF	OFF	OFF	OFF

CAUTION: Only one of these switches may be ON at any time.

*The MFJ TNC terminal baud rates of 300 and 19,200 is selected by a jumper on JMP 18 on the mother board. For 300 baud set the shorting jumper to position 2-3 and for 19,200 baud set the shorting jumper to position 1-2 (factory default).

4. After properly set the DIP switch on the back of the TNC, turn on your MFJ TNC . Note that **PWR**, **STA** and **CON** LEDs will be lit.

5. If the MFJ TNC terminal parameters match your terminal program parameter, the MFJ TNC will sign on and the **STA** and **CON** LEDs will extinguish. If TNC failed to sign-on, verify that the terminal parameters and the TNC computer baud rate is set correctly.

6. Upon signing on, the MFJ TNC will display the following sign-on message on the computer screen:

***:J**
bbRAM:LOAD WITH DEFAULTS
|A
MFJ ENTERPRISES, INC.
MODEL MFJ TNC
AX.25 LEVEL 2 VERSION 2.0
RELEASE XXXXX (date) - 32K RAM
CHECKSUM XXX
cmd:

After sign-on the **STA** and **CON** on the MFJ TNC will extinguish.

If the sign-on message fails to appear, you should check the connecting cable between and the computer and the MFJ TNC .

When you have successfully read the sign-on message from the MFJ TNC , type:

DISPLAY

followed by a carriage return. You should see a lengthy list of items on your screen. This verifies the ability of the MFJ TNC to accept and respond to input from your computer. Your serial interface is now working.

RADIO INTERFACING

Computer interfacing, covered in the previous chapter, is only half the interfacing task. The other half is connecting your MFJ TNC to your radio.

MFJ TNC Radio Port

Interfacing the MFJ TNC to your radio involves connecting the following signals at the TNC Radio Port as shown in Fig. 3-1.

Pin 1 Microphone audio, from the MFJ TNC to your transmitter.

Pin 2 Ground, audio and PTT common.

Pin 3 Push-to-talk, to allow the MFJ TNC to key your transmitter.

Pin 4 Receive audio, from your receiver to the MFJ TNC .

Pin 5 Squelch input (optional) to allow the MFJ TNC to detect activity on a shared-mode channel.

Fig.3-1 TNC Radio Port Connector

This chapter describes how to connect these signals between your MFJ TNC and your radio and how to adjust the receive and transmit audio levels appropriately. The interconnection should be planned so as to minimize pickup of stray audio and RF noise by the lines. If possible, you should set up your station with a monitor speaker and be able to operate on voice without disconnecting the MFJ TNC .

Radio Port Connection

Use Fig. 3-2 to wire a microphone connector (not provided) to the 5 pin DIN cable provided.

You may obtain the specific microphone connector pin designation for your radio from the your radio's manual. **Appendix A** at the end of this Instruction Manual lists pin assignments for some of the most popular radios. The accuracy of this information is not guaranteed. You should verify this information with your radio manual.

Fig. 3-2 Radio Port Cable with Connector

A 5-pin male DIN connector cable are provided with the MFJ TNC for wiring to the microphone connector for your radio.

CHECK THIS CABLE WITH AN OHM METER TO IDENTIFY EACH WIRE BEFORE WIRING IT TO THE MIC CONNECTOR THAT FITS YOUR RADIO.

Handheld Radio Connection

Some **HTs** key the transmitter by drawing a small amount of current from the microphone input pin (see Fig. 3-3 below). Radios with this type of special

keying circuit are ICOM-2AT (tm) and Yaesu FT-x09, FT-x3, FT-727 (tm) and others.

Appendix A at the end of this instruction manual provided pin designation for some of the radios. Also consult the instruction manual of your radio.

If your HT has this type of microphone input, you can wire the microphone like the one shown in Fig. 3-3 or you can remove the cover of the MFJ TNC and install a shorting jumper at JMP L. Installing JMP L will eliminating the need of soldering "Cx" and "Rx" to the microphone cable. "Cx" and Rx" are installed on the MFJ TNC mother board. Fig. 3-4 shows the location of JMP L header. On the MFJ TNC mother board, the "Rx" resistor for radio port is R140. If you find the your radio still would not key properly after installing JMP L, it may be necessary for you to change the value of R140 to a smaller value.

Be sure to remove **JMP L** when connecting the MFJ TNC to another type of radio.

FIG. 3-3 HT Special Keying Circuit

FIG. 3-4 MFJ TNC JMP L Header Location

RADIO INTERFACING METHODS

The MFJ TNC was designed to allow hook-up without any modifications to the radio or any signal level balancing devices in the cables. Two interfacing methods are presented.

Method 1: Direct Connection to Microphone and Speaker

For Method 1, shown in Fig. 3-5, the MFJ TNC 's audio will be fed directly into the microphone connector or similarly connected auxiliary jack, and the output of the MFJ TNC will be adjusted to give a proper modulation level. The receiver audio will be taken from an earphone plug or speaker jack and fed directly to the MFJ TNC . A monitor speaker can be connected to the SPEAKER jack of the MFJ TNC . This allows you to monitor the channel.

Fig. 3-5 Method One Interconnect.

The transmit audio level for the radio port is factory preset at 250 mV p-p to be compatible with the mic input of most radios. However, if the transmit audio is too low or distorted, adjustment may be needed. Use the following procedure to calibrate:

Transmit Audio Level Adjustment for Method I Interface

1. Connect your MFJ TNC and radio as shown in Fig. 3-5. Turn on the MFJ TNC and computer and start your terminal program. Connect the radio to a dummy load and listen to the transmission with another nearby radio.

2. Enter the modem calibration procedure by typing

CALIBRA

and a carriage return. Press the **K** key on your keyboard to key the transmitter, then tap the space bar until the higher of the two tones is heard. Pressing the **K** key again will unkey the transmitter. After the transmitter has been keyed for a few seconds, it will be shut off automatically by the transmit watch-dog circuit. As you perform the adjustments below, you will have to periodically unkey then re-key the transmitter by typing the **K** key. If you wish to defeat the watch-dog timer, install a shorting jumper at JMP4.

3. With the MFJ TNC keying the transmitter and transmitting the higher of the two tones, adjust the transmit audio level as follows. With a small screwdriver, adjust trimpot located on the left side of them MFJ TNC while you listen to the monitoring receiver. Turn the adjustment on the trimpot clockwise (CW) until no increase in output level is heard at the monitoring receiver.

4. Rotate the adjustment on the trimpot counter-clockwise until the audio signal on the monitoring receiver is reduced by half of the maximum level. This can be estimated by ear or accurately by measuring the output voltage at the transmitting audio pin of the radio port with an oscilloscope or A.C. voltmeter.

5. Press the **K** key to return to receive mode and type **Q** to exit the calibration routine. Be sure to remove JMP4 if you placed it to defeat the watch-dog timer. You have now set your transmitter deviation to approximately the correct level.

If you notice a significant hum level in the monitored audio in Step 3, take measures to remove it. This may require shielded wire (recommended in any

event) in your microphone audio circuit. If your transmitter has an adjustable microphone gain control, try reducing the sensitivity of the transmitter microphone circuit and increasing the signal level from the MFJ TNC to minimize hum or other noise problems.

Setting the Receiver Audio Input Level

The modem in your MFJ TNC is equipped with an advanced phase coherence type data carrier detector (DCD) with a sensitive tuning indicator. These can be used in combination to set the correct receive audio level for the modem and to optimize the DCD characteristics for the HF operation.

Method 2: Accessory Jack or Interface Box Connection

If your radio has an accessory jack with PTT, transmit audio, and receive audio signals, the interface can be done through this jack (shown in Fig. 3-6).

Fig. 3-6 Accessory Jack Interface.

If your radio does not have an accessory jack and you don't wish to add a connector to your radio, you may construct a separate external interface box. This box will permit simultaneous connection of your MFJ TNC and a microphone. A schematic of an external interface box is shown in Fig. 3-7.

An interface box similar to the one shown in Fig. 3-7 is available from MFJ Enterprises, Inc. or from any MFJ dealers. Model No. is MFJ-1272B.

Regardless of whether you use an accessory jack or an external interface box, you should use shielded wire for all signal carrying leads. The connector types and pinouts will be determined by the connector jacks on your radio.

Fig. 3-7 External Interface Box

If you built the external interface box as in Fig.3-7, then follow this procedure to adjust R(s).

1. Install JMP J on the MFJ TNC PC board.

2. Temporarily solder a variable resistor in place of R(s) Fig. 3-7. The maximum value of this resistor must be determined by experiment, but 500K should handle most cases. Connect your MFJ TNC to the radio. Connect the microphone to the radio, or to the interface box if one is being used. Connect the radio to a dummy load and listen to the transmission with another nearby radio. Adjust R(s) for proper modulation as follow:

Transmit Audio Level Adjustment for Interface Method II

1. Turn on the MFJ TNC and computer and start your terminal program. Enter the modem calibration procedure by typing

CALIBRA

Press the **K** key to **k**ey the transmitter, then tap the space bar until the higher of the two tones is heard. Pressing the **K** key again will unkey the transmitter. After the transmitter has been keyed for a few seconds, it will be shut off automatically by the transmit watch- dog circuit. As you perform the adjustments below, you will have to periodically unkey then re-key the transmitter by typing the **K** key. If you wish to defeat the watch-dog timer, place a shorting jumper at JMP4.

2. With the MFJ TNC keying the transmitter and transmitting the higher of the two tones, adjust the transmit audio level as follows.

3. Adjust R(s) the variable resistor installed for proper modulation level (typically between 3.0 and 4.5 kHz deviation. for Amateur FM). If FM test equipment is not available, adjust R(S) until the audio signal on the monitoring receiver is reduced by half of the maximum level. This can be estimated by ear or accurately determined by measuring the output voltage across the speaker with an oscilloscope or A.C. voltmeter. If there is not adequate audio level from the MFJ TNC to make adjustment of R(s), then you can increase the output level of the MFJ TNC by the transmit audio control on the left side of the TNC. The transmitting audio output of the radio port is factory set at 250 mV p-p.

4. Press the **K** key to return to receive mode and type **Q** to exit the calibration routine. You have now set your transmitter deviation to approximately the correct level. Remove JMP4 if you placed it in Step 4.

5. Carefully remove the variable resistor and measure its value. This is the proper value of R(S) for your particular radio.

6. Select the nearest standard value fixed resistor (1/4 watt is fine) and permanently install this resistor as R(S) in the interface circuit.

7. If you have access to FM test equipment, check to see that the modulation level is still within the limits of 3 to 4.5 kHz deviation. If it is not, make a final adjustment with the MFJ TNC transmit audio level control.

Receiver Audio Setting

The modem in your MFJ TNC is equipped with an advanced phase coherence type data carrier detector (DCD) with a sensitive tuning indicator. These can be used in combination to set the correct receive audio level for the modem and to optimize the DCD characteristics for HF operation.

With your radio in the receive mode, open the squelch control so that a steady hiss is heard on a speaker. Set the volume control to the minimum volume position. The tuning indicator on the MFJ TNC should drift off to one side of the display and become stationary. It may drift enough to disappear off the end of the display. Slowly advance the audio output level with the volume control until the tuning indicator "springs to life" and dances around a point near the middle of the display. This is the absolute minimum audio level for marginal copy. Continue to advance the volume control until there is approximately twice as much audio present at the receiver output. This can be estimated by ear or measured with an oscilloscope or A.C. voltmeter. This will be near the correct amount of audio for NBFM operation. Levels higher than this will not degrade the modem performance solong as the receiver audio amplifier is capable of producing the chosen output level without distortion (clipping).

IMPORTANT NOTE: Harmonics Interference

If you experience interference from one of the harmonics of the crystal oscillator in the MFJ TNC , trimmer capacitor, C47 (near the crystal) can be adjusted to move the frequency of the harmonic.

Monitor Speaker Connection

MFJ TNC has a built audio amplifier to provide audio for an external monitor speaker. Monitor speaker such as the MFJ- 280 can be can be connected to the **SPEAKER** jack on the MFJ TNC.

If wiring of a speaker plug is necessary, use a 3.5 mm (1/8") mono or stereo plug for this connection. Wire the plug so that the **tip** of the plug is connected to the speaker and the sleeve is connected to ground. The ring (if a stereo plug is used) is not used.

The speaker jack on the MFJ TNC is for monitoring of received and transmitted audio. It is also used to provide a signal to the operator when a packet connection is made. A small audio amplifier is built in the MFJ TNC to drive the external speaker. Volume of the monitor speaker can be adjusted by using the "Monitor" control on the left side of the MFJ TNC . If the internal amplifier of the MFJ TNC does not provide adequate volume you may use an external audio amplifier.

You can disable received audio, transmitted audio or the packet connect tone from the speaker monitor jack by cutting a trace between the pins of the following jumpers. See **Appendix G** for the locations and functions of JMP jumpers.

JMP X : Transmitting Audio
JMP Y : Receiving Audio
JMP Z : Packet Connect Tone.

For example, if you like to have the packet connect tone but do not wish to hear the racket of packet, then you should disconnect JMP X to disable the transmitted audio and disconnect JMP Y for received audio.

GETTING STARTED

This chapter will guide you through the basic packet operation on your MFJ TNC.

First Steps

1. Make sure that your computer is connected to the RS-232C port or the TTL port on the MFJ TNC according of Chapter 2.

2. Make sure that your radios are connected to the MFJ TNC according to Chapter 3.

3. Turn on your computer. Load and run the terminal program.

4. Turn on the MFJ TNC. The MFJ TNC will sign on with "cmd:" prompt sign.

***:J**
bbRAM:LOADED WITH DEFAULTS
|A
MFJ ENTERPRISES, INC.
MODEL MFJ TNC
AX.25 Level 2 Version 2.0
Release XXXXX (date) - XX K RAM
Checksum XXX
cmd:

Note: The "|A" may display as a vertical-bar and any capital letter from "A" through "J".

The first five lines are the sign-on message, which you will normally see only when you power up the MFJ TNC . The Command Mode prompt **cmd:** will appear when the MFJ TNC is in **Command Mode** and is ready to accept your instructions. Before the MFJ TNC can be fully operational, some of the basic parameters must be set.

Basic Parameters Setup

With the MFJ TNC sign-on, you are now ready to start setting up the parameters you will use. You may be satisfied with most of the defaults for now, but a few parameters will have to be changed! Let's try entering your call sign. Type:

cmd:MYCALL K5FLU
MYCALL was NOCALL
cmd:

Type the text, **MYCALL K5FLU**, following the command mode prompt. Of course, you should substitute your own call sign for **K5FLU**. Don't forget the <CR> at the end of the line. Your call sign will be used by the MFJ TNC as its "address." The MFJ TNC responds by telling you the previous value of the **MYCALL** parameter, and gives you a new Command Mode prompt.

Note that commands are entered by inserted a carriage return <CR> after each command is typed. Note also that carriage return may also be marked as <enter> on some computer keyboards.

Now try typing just the command by itself:

cmd:MYCALL

MFJ TNC will respond with:

MYCALL K5FLU

You can see the current value of most parameters by typing the command that sets the parameter followed by just a <CR>. This verifies that the MFJ TNC accepted your call sign.

The next section describes the commands you will use to configure the MFJ TNC for proper text display for your particular computer. You may not use these commands again unless you change computers or terminal programs.

Serial Port Configuration

This section describes the commands you will use to set up the MFJ TNC to work best with your computer.

Parity and Word Length

If you are using one of the optional starter packs by MFJ Enterprises, Inc. then you should follow the instructions given by the terminal program documentation with the starter pack. If you are not using the MFJ starter pack then you should use the following instructions to set the parity and word length for the MFJ TNC.

If messages from the MFJ TNC appear garbled, with incorrectly displayed characters, you may need to change the MFJ TNC 's serial port parity and word length. (We assume that you have set the baud rate correctly. See Chapter 2 if the baud rate needs to be changed.) The MFJ TNC 's default value is 8 bits and no parity. If your computer receives 8 bits as data, you may have to set space parity, since text may otherwise be interpreted as graphics or other special characters. To set 8 bits, no parity, use the following combination:

AWLEN 8 (8-bit words)
PARITY 0 (no parity bit)

For wordlength of 7 bits, even parity, set

AWLEN 7 (7-bit words)
PARITY 3 (even parity)

One of these combinations will satisfy most computers. You are more likely to require a different setting if you have a terminal rather than a computer, or if you have configured your terminal port for some special application.

If your computer requires odd parity, set **PARITY 1**. If your computer detects framing errors, try setting

AWLEN 7 (7-bit words)
PARITY 0 (no parity bit)

for shorter characters. For longer characters, set:

AWLEN 8 (8-bit words)
PARITY 1 or PARITY 3

Echos

You may see two characters on your screen for every character you type, for example:

cmd:RREESSEETT

Your computer is echoing the characters you type, and the MFJ TNC is also echoing them. In this case, set duplex to **FULL** on your terminal to stop the terminal from echoing characters to your screen.

New Lines and Line Wrapping

If everything displayed appears to be double-spaced, your computer is adding an extra linefeed (<LF>) whenever it displays a carriage return (<CR>). Set **AUTOLF OFF** to keep the MFJ TNC from also adding an <LF>. If you change equipment you may have to set **AUTOLF ON** to restore the MFJ TNC 's automatic linefeeds.

The screen-width parameter is set by default to 80, the width of many CRT displays. The MFJ TNC will send an extra <CR> (or <CR> <LF> if **AUTOLF** is **ON**) when 80 characters have been displayed on a line. If your computer does not automatically break long lines, you will need to set the screen width to the width of your display. For example, for a computer using a TV set for a display, you would set **SCREENLN 40**. If your computer does automatically break long lines, you should set **SCREENLN 0** to disable this feature on the MFJ TNC. Otherwise, you will get two <CR>s when the line wraps around.

A few computers will frequently lose the first characters of a line when several lines are typed in rapid succession, for example, in the sign-on message. You can give the computer more time between lines by setting **NUCR ON** (delay after <CR>), or **NULF ON** (delay after <LF>). The delay is adjusted by **NULLS**, which sets a number of character-times for the delay.

With the basic parameters set up which enable the MFJ TNC to be able to communicate with your computer, we can now discuss some basic functions and features of the MFJ TNC .

Tuning Indicator (MFJ-1274C)

Your MFJ TNC is equipped with a tuning indicator which is sensitive, very accurate and extremely useful not only for tuning to signals for optimum reception but also for filter alignment and audio level indication.

The position of the tuning indicator LED is only meaningful for tuning a signal under the following conditions:

1. The station is transmitting data (both tones NOT just a single carrier).

2. The DCD LED is lit indicating that the signal is within the capture range of the PLL demodulator.

3. There is sufficient audio output from the receiver for proper operation of the demodulator.

Assuming that the conditions above are met, tuning in a station with the tuning indicator is quite simple. Just set the receiver frequency so that the tuning indicator LED is centered in the display. Actually there are 2 LEDs which represent the center of the display. Either or both may be used.

PACKET OPERATION

VHF Packet

If you are not familiar with packet operation, then you can learn quite a bit about it with the MFJ TNC without actually transmitting anything. For your first experiments, the MFJ TNC will be "talking to itself," allowing you to become familiar with it before you go on the air.

If you are already familiar with the packet operation, then you may not want to perform this exercise. In this case go the other modes of operation in this chapter.

Disconnect your radio from the MFJ TNC and turn off the MFJ TNC. Install the digital loopback jumper, JMP10. The analog loopback jumper, JMP7, should not be installed at the same time. Connect your computer to the MFJ TNC with your serial cable. Turn on the computer and start your terminal program.

A Connecting and Disconnecting Exercise

Packet radio QSOs are started by a connect process, which sets up the "handshaking" between the two stations that insures error-free communications. QSOs are terminated by a disconnect process, which leaves both stations free to start new QSOs. Packet QSOs can also make use of digipeaters, other packet stations which can automatically relay packets from one station to the other over a specified route.

To see how this works, you can have the MFJ TNC connect to itself. Since you have set the MFJ TNC up for digital loop-back, it will receive all packets that it sends. Try the following:

cmd:FULLDUP ON
cmd:CONNECT K5FLU
***** CONNECTED to K5FLU**

replacing **K5FLU** with your own call sign. The MFJ TNC generates packets initiating and confirming the connection. The packets aren't actually converted to audio signals and transmitted over the radio, but they are otherwise just like packets you will be transmitting later on.

The ***** CONNECTED to** message tells you that the connection was successful. You should also notice that the CON LED has lit up and that you do not see a new **cmd:** prompt on the next line. You are now in Converse Mode, ready to start talking. Try it. Type your message, ending the line with a <CR>.

Hello, there.
Hello, there.

The <CR> causes your message to be put into a packet, or "packetized," and transmitted. (We explain in the next chapter how you can use a different character to send packets.) The underlined text is a message that the MFJ TNC received in a packet and displayed. Whenever you are in Converse Mode anything you type will be assembled into a packet addressed to the station you are talking to and transmitted. If there isn't a QSO (connection) in progress, the packet will be sent to the address **CQ**.

In the example above, the MFJ TNC entered Converse Mode automatically after the connect took place. You can also command the MFJ TNC to move

back and forth between Command Mode and Converse Mode.

To return to Command Mode, you must enter a special character, Control-C (abbreviated <CTRL-C>), or else send a BREAK signal. "Control" characters are usually entered by holding down a special control key and then typing another key without releasing the control key. If your keyboard doesn't have a key marked **CTRL** or something similar, consult the documentation for your computer or terminal program to see how to enter control characters. A BREAK signal is a special transmission (not an ASCII character) which your computer may be able to produce.

NOTE: If <CTRL-C> will cause your computer to do something to interfere with packet operations, such as halting the terminal program, and you can't send BREAK signals, you will have to change the character that returns you to Command Mode. See the section on "Special Input Characters," below.

Now type a <CTRL-C>. The MFJ TNC doesn't echo the <CTRL- C>, but you should immediately see a Command Mode prompt. To return to Converse Mode, enter the command **CONVERS**:

<CTRL-C>
cmd:**CONVERS**
Whatever I type in Converse Mode is transmitted.
Whatever I type in Converse Mode is transmitted.
<CTRL-C>
cmd:

To terminate the QSO, you must end the connect by giving the **DISCONNE** command. The MFJ TNC will transmit packets terminating the conversation and notify you when the disconnect is complete:

cmd:**DISCONNE**
*** DISCONNECTED

An actual QSO might be terminated by the other station, of course. In that case, you would see the ***** DISCONNECTED** message without having issued the command.

You have just performed the basic operations of any packet QSO. You established a connection with the desired station to begin the QSO, sent and received some messages, and disconnected from the station at the end of the QSO.

Be sure to remove JMP10 after you complete this "Connecting and Disconnecting Exercise".

Digipeating

You may wish to have a QSO with another packet station that is beyond your direct radio range. If a third packet station is on the air and both you and the station you want to talk to are in range of this third station, that station can relay your packets. You set up the packet routing when you initiate the connection. The MFJ TNC will then automatically include the routing information in the packets it sends.

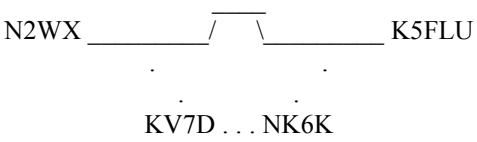
The diagram below shows an example situation in which digipeating is useful.

You are station K5FLU, and you want to have a packet QSO with N2WX. There is a mountain in the way and you are not in simplex range of each other. However there is a station located on the ridge, AD7I, which is in range of both you and N2WX.

You direct the MFJ TNC to set up a connection to N2WX using AD7I as an intermediate digipeater as follows:

cmd:**CONNECT N2WX VIA AD7I**

You can specify a routing list of up to eight intermediate stations. For example, consider a modification of the example above:



AD7I has turned off his station, but you can contact N2WX by going around the mountain through NK6K and KV7D. This time you issue the connect command like this:

cmd: **CONNECT N2WX VIA NK6K, KV7D**

You specify the digipeaters in the order you would encounter them going from your station to the station to which you wish to connect.

Your station can also act as a digipeater for other stations. This doesn't require any special actions on your part -- the MFJ TNC will do everything automatically. If your station is digipeating, you may occasionally notice your transmitter keying during lulls in your own conversations.

Unsuccessful Connections

Sometimes you will initiate a connect sequence that can't be completed. The station may not be on the air, or it may not be within range of your station. You may have even mis- typed the other call sign. If the MFJ TNC does not get a response to its first connect packet, it will try again. You can control the number of attempts the MFJ TNC will make with the command **RETRY**. The default number of retry attempts is 10. If the MFJ TNC doesn't get an answer after this number of transmissions, it will give up and display the message

***** retry count exceeded**
***** DISCONNECTED**

The retry count is also used once the QSO has started. Each transmission sent to the other station is "acknowledged," or ACKed by the other station, and vice versa. The ACK means that the packet was received and that the CRC checksum indicated that it was received without errors. This is the means by which packet radio can ensure error-free communications. Sometimes a packet won't be received correctly by the other station, either because of accidental interference from another packet station (a collision), or because of other channel noise. If the MFJ TNC doesn't get an ACK soon enough, it retransmits the packet and increments the retry count. If the count set by **RETRY** is exceeded, the MFJ TNC will automatically disconnect and display the same message:

***** retry count exceeded**
***** DISCONNECTED**

The automatic disconnect feature keeps a MFJ TNC from indefinitely retransmitting a packet and tying up the channel under hopeless conditions. For example, an intermediate digipeater might have been shut down, or the RF channel might have deteriorated to the point of being unusable. The other operator might have even turned off his station without disconnecting. If you

are operating under special conditions, such as a marginal HF channel, you can set **RETRY 0** to disable all automatic disconnects (the retry limit is never reached).

Monitoring Channel Activity

In addition to displaying messages from the station you are connected to, the MFJ TNC can allow you to monitor other packet activity on the channel. You can "read the mail," displaying packets between other stations. The MFJ TNC will also keep track of stations heard during a session. This section will describe some of the monitor functions.

Monitoring is enabled or disabled by the **MONITOR** command. You can try this out in digital loop-back mode while disconnected. Type:

cmd:MONITOR ON
cmd:CONVERS
This is a test packet.
K5FLU>CQ:This is a test packet.

Since you aren't connected to another station your packets are sent to the address "CQ," i.e., anyone. The packet you sent was "heard" by the MFJ TNC and displayed, along with the sending station and the destination.

If you also want to see any intermediate digipeater stations being used, you can set **MRPT ON**. This feature would be useful if you later want to connect to one of the stations you are monitoring and will need a digipeater route in order to reach it. For example, you might see the following display:

WB6YMH>WD0ETZ,KV7B:Hello, Bill!

This packet was sent from WB6YMH via KV7B to WD0ETZ.

If there are several digipeaters, or if the message lines are long, the display may be difficult to read. You can put the address header on a separate line from the text by setting **HEADERLN ON**:

WB6YMH>WD0ETZ,KV7B:
Hello, Bill!

Ordinarily, the MFJ TNC will stop displaying monitored packets if you connect to another station, permitting you to converse without interruption. If you want to monitor activity while connected to a packet station, set **MCON ON**.

To display a list of stations heard since the last time your MFJ TNC was powered up, type

cmd:**MHEARD**
AD7I
WA7GXD
N2WX
NK6K
KV7B*

The last several stations whose packets were heard by your MFJ TNC are displayed. The entry "KV7B*" means that KV7B was heard digipeating a packet rather than sending one of his own. You can clear the "heard log" with the command **MHCLEAR**.

You can see the settings of the monitor parameters described above, as well as several others, by typing **DISPLAY MONITOR**.

Your First Packet QSO

Although there are still a number of features you should be familiar with for comfortable packet operation, you are probably eager to get on the air and try out the MFJ TNC . Arrange to have another packet operator get on the air to help you get started. Make sure that your friend will be close enough to ensure solid copy, with no FM "popcorn" noise. It's best if you can get an experienced packet operator to help you get started. If you are both beginners, try to have both stations in the same room and operate on low power or into dummy loads.

Remove the digital loopback jumper, JMP10. Connect your radio to the MFJ TNC. Turn on your computer, the MFJ TNC, and your radio. Be sure you have adjusted the MFJ TNC and radio according to one of the methods described in Chapter 3. When the other station transmits, the DCD LED on the MFJ TNC should glow steadily for the duration of the transmission. You can work

through the remainder of the examples in this chapter while you try out the MFJ TNC on the air.

Starting the QSO

You are ready to initiate a connect. For the sake of example, we will continue to use K5FLU in place of your call sign, and we will use WB0QRP for your friend's call. Make sure you are in Command Mode, and type

cmd:CONNECT WB0QRP

After a moment you should see the message

***** CONNECTED to WB0QRP**

and you will be in Converse Mode. Your friend will see the message

*** CONNECTED to K5FLU

and he will also be in Converse Mode. You have begun your first QSO.

If you have trouble connecting, make sure your microphone drive level is set properly, as described in Chapter 3. It may be helpful to have an experienced packet operator listen to your transmissions and monitor with his TNC. You can also try the following procedure. Both you and your friend should set **MONITOR ON**, enter Converse Mode and send some packets. Each station should display packets sent by the other. If only one station is "hearing" properly, you can concentrate on the modulator and transmitter of that station and the demodulator and receiver of the other station. You can try experimenting with the **TXDELAY** timing parameter for the sending TNC. Set **TXDELAY 64** for a long delay. If this solves the problem, you can back off to the smallest value that works consistently.

Exchange several messages to get a feel for this new mode. If you monitor the radio transmit indicators and listen to the speaker audio from the two rigs, you will have a better idea of what is happening. You radio will be inactive most of the time, even while you are actually typing. When you get to the end of a line and type a <CR>, your radio will be keyed briefly and your friend will hear a

"brrrraaaap" on his speaker. As your message is displayed on his computer, his radio will be keyed for an even shorter time and you will hear a "brraap" on

your speaker. This is the ACK, or packet acknowledgment coming back. The MFJ TNC takes note that the packet was received correctly, but nothing is displayed on your screen.

Digipeating

Now that you are on the air, you and your friend can try out the MFJ TNC 's digipeating capabilities. This is actually more interesting if you have at least three stations participating, but you can get the feel for it with two stations.

Return to Command Mode and disconnect from the other station:

<CTRL-C>
cmd:DISCONNE
***** DISCONNECTED**

Now issue the following command.

cmd:CONNECT K5FLU VIA WB0QRP

As before, substitute your call for K5FLU and your friend's call for WB0QRP. You are requesting a connect to yourself, as you did before in digital loop-back mode, but this time you are using a sort of RF loop-back. You transmit packets to your friend's TNC, which relays them back to you. When the connection is established you will see

*** CONNECTED to K5FLU VIA WB0QRP

and you will be in Converse Mode. Your friend won't see anything displayed on his computer and his TNC's state won't be affected at all by your QSO. In fact, your friend could issue this connect request,

cmd:CONNECT WB0QRP VIA K5FLU

and you can carry on two separate conversations completely independently. Monitor the radio transmit indicators and listen to the speaker audio. See if you can follow the packets and the acknowledgments back and forth.

Monitoring on the Air

This is a good time to try out the MFJ TNC 's monitor functions. While you and your friend are separately connected, type

<CTRL-C>

cmd**:MONITOR ON**
cmd**:MCON ON**
cmd:**CONVERS**

You will be able to see both your "conversation" and your friend's conversation. Also try **HEADERLN ON** and **MHEARD**.

Special Input Characters

The MFJ TNC has a number of special characters that can be used to control its actions. Many of these special characters can be used to "edit" commands and packet text as they are entered. These features can all be customized to suit you and your computer. Most of the special input characters we will describe are active in both Command Mode and Converse Mode; the exceptions will be noted.

The character used to return to Command Mode from Converse Mode is by default a <CTRL-C>. (Sending a BREAK signal also works.) This character does nothing in Command Mode, so if you accidentally enter it twice you won't mess up the next command line. You can change the Command Mode entry character with the command **COMMAND**. This is one of several commands that set special character functions. You can choose any character for this function, by entering the ASCII character code for the key. For example, you can use a <CTRL-E> to enter Command Mode by setting

cmd:**COMMAND 5**
was $03
The MFJ TNC displays the previous value in hex, and you can also enter character codes in hex if you prefer. All of the special characters described below can be changed in the same way as **COMMAND**.

We have already mentioned that you can erase mis-typed characters by typing the <BACKSPACE> character. You can change this character with the

command **DELETE**. If you set **DELETE ON**, you can erase characters by typing the <DELETE> character; setting **DELETE OFF** returns to using <BACKSPACE>. You will probably want to use the same key that your computer normally uses to rub out characters. <BACKSPACE> is more commonly used than <DELETE> by personal computers. If you aren't sure whether your rubout key produces <DELETE> or <BACKSPACE> characters, you can try both settings of the **DELETE** command and see which works.

When you rub out a mis-typed character, the MFJ TNC will attempt to correct the screen display. This will work for most computers as well as display-type terminals. It won't work for hardcopy-type terminals or possibly with a few computers. If your display doesn't look right after you rub out a character, try setting **BKONDEL OFF**. The MFJ TNC will not try to correct the display but will indicate the rubout with a "\" character (<BACKSLASH>). You can restore display correction by setting **BKONDEL ON**.

If you make several mistakes in a line, or if you change your mind, you may want to cancel the whole line rather than rubbing out the characters one at a time. You can cancel the line by typing <CTRL-X>. The MFJ TNC will display a <BACKSLASH> followed by <CR>. If you are in Command Mode, you will see a new prompt:

cmd:**Hi, John, how are you?<CTRL-X>**\
[You started typing text while in Command Mode.]
cmd:**CONVERSE**
Hi, John, how are you?

The cancel-line character can be changed to any ASCII character by the command **CANLINE**.

If you have changed your input by rubbing out and retyping characters, you may want to see a "fresh" copy of your input, especially if you have set **BKONDEL OFF**. The MFJ TNC will retype the line you are entering when you type <CTRL- R>:

cmd:**CONNECT KB7\\\WA7<CTRL-R>**\
[You mis-typed the call sign.]
cmd:CONNECT WA7**GXD**

Here the user mis-typed the first three characters of the call sign and rubbed them out. The MFJ TNC displayed "\" for each character rubbed out. The user then retyped the characters correctly and redisplayed the line. He finished typing the call sign on the new line. The redisplay-line character can be changed to any ASCII character by the command **REDISPLA**.

If the MFJ TNC displays information faster than you can read it before it scrolls off the screen, you can halt the display by typing <CTRL-S>. To resume

output from the MFJ TNC to your computer, enter <CTRL-Q>. These characters can be changed to any ASCII character by the commands **STOP** and **START**, respectively.

You may occasionally want to include one of the special input characters in a packet. For example, to send several lines at once in the same packet, you would have to include <CR> in the packet at the end of each line, bypassing its "send-packet" function except at the actual end of the packet. You can include any character in a packet including all special characters by prefixing it with the pass character, <CTRL-V>. For example,

I wasn't at the meeting.<CTRL-V><CR>
What happened?

Ordinarily, this message would be sent as two packets. By prefixing the first <CR> with <CTRL-V>, the operator sends it all at once, but maintains the <CR> in the text. The pass character can be changed to any ASCII character by the command **PASS**.

We will discuss operation of packet in more detail in the next chapter. For now let us discuss the operation of HF packet with the MFJ TNC.

HF Packet Basic Operation

The requirements for optimum performance with a typical HF or OSCAR 10 path are very different compared to local VHF FM environment. Lower signal to noise ratios require lower baud rates, noise spikes and fades require shorter packet lengths, and a higher rate of false carrier detects lowers the total usable dynamic range in the audio input. The MFJ TNC hardware and software are configured to improve throughput in these environments. The MFJ TNC s settings of **MAXFRAME** and **PACLEN** provide the possibility of several

continuous frames of long data length. For HF operation at 300 baud, we recommend setting **MAXFRAME** to 1.

The MFJ TNC detects a busy channel by monitoring the lock- detect signal from the demodulator. The presence of a lock- detect signal is indicated by the Data Carrier Detect (DCD) LED. Each time DCD goes off the MFJ TNC will start a **DWAIT** interval which must elapse before the channel is considered to be available. On a noisy channel spurious lock-detect signals may be generated. For HF and OSCAR operation you should set **DWAIT** to 0. The random wait before retry transmissions can be disabled by setting **TXDELAY**

0 and using **AXDELAY** to set the required keyup delay. Of course, **AXHANG** should be 0 for this application.

If you are operating a full-duplex radio station (simultaneous transmit and receive) such as an OSCAR 10 station, you should set **FULLDUP ON.** The MFJ TNC is always electrically capable of full duplex operation, but this parameter causes the protocol to behave differently in acknowledging packets. In addition, the MFJ TNC will ignore the state of the DCD line.

Although intuition tells you that lower baud rates will reduce the number of packet retries, there is usually a small range between "too fast" and "too slow." A slower packet takes longer to transmit and is therefore a larger target for fades and static crashes. The entire packet must be received correctly in order to be accepted. Data rates of 1200 baud have been used on both HF and through OSCAR 10.

HF activity may generally be found on 7.093 or 14.107 MHz. Use LSB or USB - it really doesn't matter (although most stations use LSB when referring to the suppressed carrier frequency).

Tune through a few packet signals. Tune slowly! You will find a point at which the display becomes bright. As you continue tuning, you will see the moving bar display slide across your tuning indicator. When one of the center LEDs is illuminated, you are tuned in and you should be able to copy the packets.

Each bar on the tuning indicator represents about 10 Hz. Thus, if a packet comes through and you are 4 bars off, re- tune your transceiver 40 Hz in the indicated direction. The direction depends on the sideband you selected and the manner in which you have the tuning indicator oriented. One or two tries will

quickly tell you which way to go! Bars to the left of center indicate you should tune higher, while the other side of center means to tune lower.

Many BBS station forward traffic on HF at the above frequencies. Call CQ a couple KHz away from such channels. If you can't raise anyone, call CQ on one of the above frequencies, **but QSY immediately after establishing contact!** Be careful on 20 meters especially that you don't operate +/- 2KHz

around 14.100 MHz (you will cause interference to propagation beacons and give packet a bad name...)

HF Packet Operation Hints:

1. Try to keep all packets below 80 characters in length.
2. Set **MAXFRAME** to 1. This will minimize transmission time.
3. Avoid multiple connections and digipeated packet operation.
4. Qsy away from the standard calling frequencies as soon as possible.
5. Set **FRACK** to a sensible long value.

More detail on HF packet operation is discussed in the next chapter in this instruction manual.

FAX OPERATION

The MFJ TNC is capable of receiving 2-level FAX. FAX receiving is possible only if you are using an optional terminal progrom provided by the MFJ Starter Pack. The MFJ TNC supports only the Weather FAX mode (120 line per minute) format.

If you are interested in FAX receiving and transmiting, we suggested that contact MFJ Enterprises, Inc. to inquire about about the MFJ TNC muiltmode data controller which is capable of receiving and transmitting up to 16 gray-level. MFJ also offers model MFJ-1214 for IBM and compatible PCs. It is capable of transmit and receive 16-levels FAX and color FAX. It also supports RTTY and CW modes.

MFJ Enterprises, Inc. offers terminal software for some computers to support this operation. This software allows you to print FAX pictures to screen in near

real time and to save FAX pictures to disk. FAX pictures saved on disk can be recalled for viewing on the screen at any time.

MFJ terminal programs which support 2-level FAX receiving operation are as follows:

1. MFJ-1284 for IBM PC and compatibles in 5-1/4" disk.
2. MFJ-1284M same as above but in 3-1/2" disk.
3. MFJ-1287 for Apple Macintosh computer.
4. MFJ-1282 for Commodore C-64 and C-128 in 5-1/4"disk.

If you are using one of the above terminal programs which supports 2-level FAX operation you should follow the instruction given by the terminal program

to receive FAX.

FAX FREQUENCY

FAX transmitting stations are usually found on the HF bands.Weather FAX stations are generally upper sideband. Some of these stations maintain a regular schedule. The following table lists the frequencies of some FAX stations.

FAX STATION FREQUENCIES

Service	Band	Frequency (KHz)
Weather	USB	3,357.00 4,268.00 4,975.00 6,946.00
		10,865.00 12,125.00 20,015
Photographs	LSB	10,680.70 17,673.90 18,434.90,
		20,738.00

Other FAX Frequencies

The following frequencies were obtained from Popular Communication Magazine:

FREQUENCIES(KHz, USB)	LOCATIONS
4,271.00 9,890.00 13,510.00	Halifax, Canada
8,502.00 12,750.00	Boston, MA
9,389.50 11,035.00	Brentwood, NY
4,793.50 10,185.00 12,201.00 14,671.50	Washington, DC
9,157.50 17,447.50	Mobile, AL
8,080.00 10854.00 15,957.1 16,410.00	Norfolk, VA
4,802.50 9,440.00 13,862.50	Hawaii
7,770.00 11,090.00 13,627.50	Hawaii
8,459.00	Alaska
4,346.00 8,682.00 12,730.00 17,151.20	San Francisco, CA
8,646.00 17,410.50	San Diego, CA

ADVANCED PACKET OPERATION

This chapter describes some aspects of packet operation that you don't need to be concerned with for everyday conversational operation. You will want to consult this chapter if you are using your station for special applications such as a Packet Personal Mailbox, Bulletin Board, binary file transfers, Packet picture transfers or running a "host" program. This chapter also discuss use of the newly developed packet anti-collision feature. HF and OSCAR packet operation is also discuss in detail in this chapter.

We will use the term "computer" to refer to computers or terminals. In the command examples, the MFJ TNC's prompts and other messages are shown in ordinary type, your responses are shown in **bold face**, and received packets are shown underlined. Commands and other special keywords are shown in upper case; other text entered to the MFJ TNC is shown in upper and lower case.

Special Characters

The MFJ TNC recognizes a number of special characters for input editing, flow control, and other control functions. You can change any of these special characters to customize the MFJ TNC to suit your applications, your computer, or your whim. Most of the characters are set by commands which specify the ASCII character code for the desired character. You can disable any special character feature by setting the character value to 0. Input editing characters may be disabled with no serious effects. You should use caution in disabling the flow-control or Command Mode entry characters. Also be careful not to set two special characters to the same value.

Special characters are normally set to various control characters. Control characters are entered by holding down a special control key while typing another key. For example, control-C, or <CTRL-C> is entered by holding down the control key while typing **C**. If your computer doesn't have a special control key, you will have to consult your computer's documentation to see how to enter these characters. If you will have difficulty entering control characters, you can change the special characters to, for example, seldom- used punctuation.

The action of each special character is described in detail under the entry in Chapter 6 for the command that sets that character.

You can enter the code for a character in either hex (base 16) or decimal notation. The MFJ TNC displays character codes in hex. A number in hex notation is indicated by beginning the number with a **$**. The "digits" of a hex number represent multiples of powers of 16. The values 10 through 15 are represented by the letters **A** through **F**, which may be upper or lower case. For example,

$1B = 1 x 16 + 11 = 27.

Tables of ASCII character codes are available in most computer manuals. A table of ASCII codes for control characters follows.

Dec	Hex	Control	Mnemonic	Dec	Hex	Control	Mnemonic
0	$00	<CTRL-@>	NUL	16	$10	<CTRL-P>	DLE
1	$01	<CTRL-A>	SOH	17	$11	<CTRL-Q>	DC1
2	$02	<CTRL-B>	STX	18	$12	<CTRL-R>	DC2
3	$03	<CTRL-C>	ETX	19	$13	<CTRL-S>	DC3
4	$04	<CTRL-D>	EOT	20	$14	<CTRL-T>	DC4
5	$05	<CTRL-E>	ENQ	21	$15	<CTRL-U>	NAK
6	$06	<CTRL-F>	ACK	22	$16	<CTRL-V>	SYN
7	$07	<CTRL-G>	BEL	23	$17	<CTRL-W>	ETB
8	$08	<CTRL-H>	BS	24	$18	<CTRL-X>	CAN
9	$09	<CTRL-I>	HT	25	$19	<CTRL-Y>	EM
10	$0A	<CTRL-J>	LF	26	$1A	<CTRL-Z>	SUB
11	$0B	<CTRL-K>	VT	27	$1B	<CTRL-[>	ESC
12	$0C	<CTRL-L>	FF	28	$1C	<CTRL-\>	FS
13	$0D	<CTRL-M>	CR	29	$1D	<CTRL-]>	GS
14	$0E	<CTRL-N>	SO	30	$1E	<CTRL-^>	RS
15	$0F	<CTRL-O>	SI	31	$1F	<CTRL-_>	US
				127	$7F	<DELETE>	

Table 5-1. ASCII Codes for Control Characters.

Packet Operating Modes

In Chapter 4 we discussed two of the packet operation modes, Command Mode and Converse Mode. Packet also can operate in the third mode, Transparent Mode which is a data-transfer mode like Converse Mode but is intended primarily for computer data interchange rather than human conversation. We describe all three of these modes below.

Command Mode

Command Mode is used to enter commands which alter the MFJ TNC's operating parameters. The other modes are entered from Command Mode. When the MFJ TNC is in Command Mode, the Command Mode prompt,

cmd:

is printed at the beginning of each input line. Note, however, that if the MFJ TNC has received and displayed packets, the prompt may have scrolled off the screen.

The MFJ TNC will be in Command Mode after a reset or power-up. After a power-off, power-on sequence, all operating parameters of the MFJ TNC are re-initialized to the parameter stored in battery backed-up RAM (bbRAM) by the resident software. After the **RESET** command is issued all operating parameters are reset to the default values stored in EPROM. The values of most parameters are stored in a permanent but easily changed form in the bbRAM memory.

The following commands set special characters which are active in Command Mode. Refer to the discussions of these commands in Chapter 6 for details on the operation of the characters in Command Mode. Also see the section on special input characters in Chapter 4.

CANLINE Cancel current line
CANPAC Cancel output (Command Mode function only)
DELETE Character deletion
PASS Insert following special character
REDISPLA Re-display current line
START, **STOP** User's flow control characters (sent to MFJ TNC)

XOFF, **XON** MFJ TNC flow control characters (sent to terminal)

The following commands enable display features which are active in Command Mode. Refer to the discussions of these commands in Chapter 6 for details on the operation of these characters in Command Mode. Also see the section on terminal configuration in Chapter 4.

AUTOLF	Add <LF> after <CR> in data sent to terminal
BKONDEL	Echo after character deletion
ECHO	Automatic echo of serial port input
FLOW	Type-in flow control
LCOK	Lower case translation
NUCR	Nulls after <CR>
NULF	Nulls after <LF>
NULLS	Null count
SCREENLN	Automatic <CR> insertion

Entering Data-Transfer Modes

There are several ways to enter a data-transfer mode from Command Mode. You can type the command **CONVERS** or **K** to enter Converse Mode or the command **TRANS** or **T** to enter Transparent Mode, and the MFJ TNC will immediately enter the specified mode. The MFJ TNC will automatically enter a data-transfer mode if you are in Command Mode when a connection is completed. You can specify the data-transfer mode for automatic entry with the command **CONMODE**:

cmd:**CONMODE TRANS**

will specify Transparent Mode, and

cmd:**CONMODE CONVERS**

will return to the default choice of Converse Mode.

The timing of the automatic entry into data-transfer mode depends on whether you or the other station initiated the connection. If you receive a connect request which your MFJ TNC accepts, you will enter data-transfer mode when the MFJ TNC sends the connect acknowledgment (ACK) and types the message ***** CONNECTED TO <callsign>**.

If you initiate the connection with the **CONNECT** command, you can control the timing of the mode change with the command **NEWMODE**. If **NEWMODE** is **OFF**, the mode will change when the connect ACK is received

and the ***** CONNECTED TO: <callsign>** message is typed. If **NEWMODE** is **ON**, you will enter data- transfer mode immediately, without
waiting for a successful connection. Any text sent to the MFJ TNC at this point will be queued up in packets which will wait for a successful connection before being sent. If the connect attempt fails, you will be returned to Command Mode. You will also be returned automatically to Command Mode when either station disconnects and ends the QSO.

Converse Mode

The data mode used most often for ordinary QSOs is Converse Mode. In Converse Mode, the information you type is assembled by the MFJ TNC into packets and transmitted over the radio. The send-packet character causes the input to be packetized for transmission. If you type a full packet- length of characters without typing the send-packet character, your input will be packetized and transmitted anyway.

The default send-packet character is <CR>, but you can specify any character with the command **SENDPAC**. You may also choose to have the send-packet character transmitted in the packet or not. If the send-packet character is <CR> it is natural to include it in the packet as part of the text as well as interpreting it as a command. This is accomplished by setting **CR ON**. If you use some other character to force packet transmission, you may want to set **CR OFF** and inhibit transmission of the send-packet character. If you set the send-packet character to something other than <CR>, you can cancel packets of more than one line with the cancel-packet character, which is set with the command **CANPAC**. Single-line packets can be canceled with either the cancel-line character or the cancel-packet character.

To return to Command Mode from Converse Mode you must type the Command Mode entry character, or send a BREAK signal over the serial port. A BREAK is not a regular ASCII character, but it can frequently be transmitted by typing a special key on the keyboard.

A BREAK signal is a continuous space (or 0) signal on the serial port Transmit Data line lasting approximately 0.2 second. In fact, the timing of the signal is

not very important, and most serial ports will recognize a BREAK if the space signal lasts significantly longer than the time required for a character transmission. Because of the simple nature of this signal, it is easily possible to generate a BREAK with circuitry external to the computer, thus guaranteeing entry to Command Mode in automatic station operation.

The following commands set special characters which are active in Converse Mode. Refer to the discussions of these commands for details on the operation of the characters in Converse Mode.

CANLINE	cancel current line
CANPAC	cancel current packet
COMMAND	Command Mode entry
DELETE	character deletion
MFILTER	characters to be filtered in monitored packets
PASS	insert following special character
REDISPLA	re-display current line
SENDPAC	send current packet
START, **STOP**	user's flow control characters (sent to MFJ TNC)
XOFF, **XON**	MFJ TNC flow control characters (sent to to terminal)

The following commands enable display features which are active in Converse Mode. Refer to the discussions of these commands for details on the operation of these characters in Converse Mode.

8BITCONV	Retain high-order bit from serial port in converse mode
AUTOLF	Add <LF> after <CR>
BKONDEL	Echo after character deletion
ECHO	Automatic echo of serial input
ESCAPE	<ESCAPE> translation
FLOW	Type-in flow control
LCOK	Lower case translation
NUCR	Null characters after <CR>
NULF	Null characters after <LF>
NULLS	Null count
SCREENLN	Automatic <CR> insertion

Transparent Mode

Packet radio is very well suited to the transfer of data between computers. In some cases Converse Mode will work well for computer data transfer. However, files such as a .CMD file on a CP/M system, a BASIC program, or even a word-processor text file, may contain characters which conflict with special characters in Converse Mode. Some of these files may utilize all eight bits of each byte rather than the seven bits required by ASCII codes. If you transfer such files you will have to use Transparent Mode.

Transparent Mode is a data-transfer mode like Converse Mode. In this mode there are no special characters, everything you type (or everything your computer sends to the MFJ TNC) is sent over the radio exactly as it was received by the MFJ TNC. There are no input editing features and there is no send-packet character. Packets are sent at regular time intervals or when a full packet of information is ready. The time interval at which data is packetized is set by the **PACTIME** command.

The display characteristics of the MFJ TNC are also modified in Transparent Mode. Data is sent to the computer exactly as it is received over the radio, including all 8 bits of each byte received. Features such as auto-linefeed insertion and screen wrap are disabled, and echoing of input characters is disabled. The parameters that control these features in Command Mode and Converse Mode are not changed by entering Transparent Mode, and all display features are re-enabled when the MFJ TNC is returned to Command Mode. Most of the link status messages that appear as the MFJ TNC moves between disconnected and connected states are also disabled in Transparent Mode.

In order to permit the Command Mode entry character to be transmitted freely in Transparent Mode, the escape to Command Mode from Transparent Mode has been made a little more complicated. You can still return to Command mode by transmitting a BREAK signal, just as in Converse Mode. You can also utilize the Command Mode entry character in the following way.

You must wait for a time period after typing the last character to be sent. This time is set by the command **CMDTIME**. Following this wait, you must type three Command Mode entry characters (default <CTRL-C>) within an interval **CMDTIME** of each other. After a final **CMDTIME** interval in which no characters are typed, you will see the

cmd:

prompt. If any characters are typed during this interval (even Command Mode entry characters) the escape will be aborted and all the Command Mode entry characters that have been typed will be sent as packet data. If you set **CMDTIME** to zero you will not be able to escape from Transparent Mode using this second procedure.

Flow Control

Whenever data is transferred to computers (home computers or TNCs), there is a chance that the data will be received faster than the computer can handle it. Some programs try to deal with this by providing data buffers for storing incoming data until the program is ready for it. However, this merely postpones the problem, since there is a limited amount of room in any buffer. In order to prevent loss of data the computer must be able to make whatever is sending data stop sending, and later tell it to resume sending. If you are a home computer user, you are probably already familiar with one type of flow control, which allows you to stop the output from the computer while you read it and restart it when you are ready for more.

The MFJ TNC's input buffer may fill up in Command Mode if you try to type too long a command. In Converse Mode the buffer may fill up for any of several reasons: you may be using a faster serial port baud rate than the radio data rate; radio data transmission may have slowed down because of noise or other users on the channel; the person or computer at the other end may have stopped output from that TNC. The MFJ TNC will signal the computer to stop sending data when there is room remaining for about 80 characters in the buffer. When the buffer fills up entirely, data will be lost. When the buffer empties so that there is room for at least 270 characters, the MFJ TNC will signal the computer to start sending data again.

A computer file transfer program may be unable to process data fast enough to keep up with output from the MFJ TNC. In order to be sure of reading every character, a computer must respond to interrupts from its I/O devices. Some simple programs may poll the input register for new data. If the polling is not done often enough, data may be lost. Some computers disable interrupts during disk accesses. If the program enters a routine which will not allow it to check for data or respond to it, it should signal the MFJ TNC to stop sending data.

There are two methods of providing flow control which are supported by the MFJ TNC. XON/XOFF flow control, sometimes called "software flow control," is accomplished by sending a special character (usually <CTRL-S>) to request

that the output stop and another special character (usually <CTRL-Q>) to restart output. Hardware flow control may be used if both computers use the C,ear To Send (CTS) and Data Terminal Ready (DTR) lines of the RS-232C standard. Data is also halted if you press the space bar while in command mode. Press <CR> to resume.

Some commonly used terminal programs and file transfer programs for home computers do not implement flow control in software, and many serial ports do not support hardware flow control. Although the DTR and CTS lines appear at the connector, they may not be used on some computers unless the software reads the state of the CTS line. If you find that the MFJ TNC seems to lose data during file transfers, you should immediately suspect a flow control problem.

XON/XOFF Flow Control

If you are using a terminal (rather than a computer) or if your computer does not support DTR/CTS flow control, you should use XON/XOFF flow control, which is enabled by setting **XFLOW ON**. The special flow control characters are set to <CTRL-S> and <CTRL-Q> by default, but they may be changed.

The commands **XON** and **XOFF** set the characters which will be sent to the terminal by the MFJ TNC, and the commands **START** and **STOP** set the characters to be sent to the MFJ TNC by the terminal. Your computer may receive as many as 4 characters from the MFJ TNC after sending a STOP character, since some characters may already be "in route" through serial I/O chips.

If you send a STOP (START) character to the MFJ TNC when it is already stopped (started), the character will be ignored. If the STOP and START character are the same character, this character will "toggle" the output, turning it off if it is on, and on if it is off.

You can disable XON/XOFF flow control in one direction only by setting the appropriate flow control characters to 0. If you do this, the MFJ TNC will automatically use CTS flow control to stop input from the terminal. XON/XOFF flow control is normally disabled in Transparent Mode, since all characters are treated as data. If you cannot use DTR/CTS flow control, you may enable the XON and XOFF characters (the commands from the MFJ TNC to the terminal) by setting **TXFLOW ON** and **XFLOW ON**. The START and STOP characters (the commands to the MFJ TNC from the terminal) can be enabled in

Transparent Mode by setting **TRFLOW ON**. Note that the mode is no longer truly transparent when these features are enabled.

Hardware Flow Control

Hardware flow control is less likely to depend on the programming of a particular communications program. DTR and CTS are normally used for flow control signals in Transparent Mode. The command **XFLOW OFF** enables hardware flow control in Converse Mode and Command Mode. Your computer may receive as many as 2 characters after it signals the MFJ TNC to stop sending, since some characters may already be "in route" through serial I/O chips. Refer to Chapter 7, Hardware for details on the interface required for hardware flow control.

Type-in Flow Control

Type-in flow control, enabled with the command **FLOW**, is really a display feature. It can keep the MFJ TNC from interrupting you with incoming packets when you are in the middle of typing a command line or an outgoing packet. As soon as you type the first character of a line, the MFJ TNC will put

a "hold" on all output (except for echoing your input). The "hold" remains ineffect until you type a <CR> to end the command line, or a send-packet character to mark the end of a packet, or until you erase or re-display the line you have started.

Some computers have difficulty simultaneously sending and receiving characters over the serial port. This is most commonly the case for computers with "software UARTs." Type-in flow control will improve the operation of such computers with the MFJ TNC.

Detail VHF Packet Operation

The previous chapter's discussion of "Basic Operation" contains enough information for most packet operation. This section describes a few other aspects of packet operation.

Station Identification

Your station identification (call sign) is set with the command **MYCALL**, as described in the previous chapter. If you will have more than one station on the air operating with the same call sign, they must be distinguished -- no two stations can have identical station identifications, or the packet protocol will fail. You can distinguish additional stations by setting the "secondary station ID", or SSID. This is a number from 0 to 15, appended to the call sign with a dash:

cmd:**MYCALL W3IWI-3**

If you don't specify the SSID extension, it will be 0, and the MFJ TNC won't explicitly show SSIDs that are 0. If you want to connect to a station with a SSID other than 0, or use such a station as a digipeater, you must specify the SSID:

cmd:**CONNECT AD7I-2**
or
cmd:**CONNECT WA7GXD VIA N7CL-5**

The MFJ TNC can send an automatic identification packet every 9-1/2 minutes when your station is operating as a digipeater. You can enable this feature with the command **HID ON**. An ID packet is displayed as follows by a monitoring station:

W3IWI-3>ID:W3IWI/R

You can request a final identification as you take your station off the air with the command **ID**. The MFJ TNC will only send identification packets if it has been digipeating.

Automatic Operations

Normally, any packet station can be used by other stations for relaying, or digipeating, packets to a more remote destination. If you don't want your station digipeating packets, you can give the command **DIGIPEAT OFF**. Unless there are special circumstances, such as a station operating on emergency power, most packet operators set **DIGIPEAT ON** in the spirit of Amateur cooperation.

Your station will normally accept a connect request from another station if it isn't already connected. You can disable this capability by setting **CONOK OFF**. If you receive a connect request when **CONOK** is **OFF**, the MFJ TNC will display the message

*** connect request: <callsign>

and send a "busy signal" rejection packet to the other station. If you receive a rejection packet from a station you try to connect to, your MFJ TNC will display

*** <callsign> busy
*** DISCONNECTED

If you want to have a special message sent automatically to stations connecting to you, you can specify the message with the command **CTEXT**. This message can consist of any text string up to 120 characters, and you may include <CR>s by prefixing them with the pass character:

cmd:**CTEXT Sorry, I can't talk right now.<CTRL-V><CR>**
I'll be on the air again after 8 PM.<CTRL-V><CR>
Joe

In order for this message to be sent to stations connecting to you, you must set **CONOK ON** so that the connection takes place (default), and enables the automatic message with **CMSG ON**.

If you want to leave your station on but inhibit transmitting, you can set **XMITOK OFF**. If you do this, you would normally set **CONOK OFF** as well.

You can have your station periodically send an automatic message by enabling "beacons." A beacon can be used to make general-interest announcements, provide packets for other stations to use to test their ability to receive, or announce the presence of a bulletin-board operation. The beacon message is set with the command **BTEXT**, which works the same way as the **CTEXT** command. You enable beacon transmission and set the frequency at which

beacons are sent with the command **BEACON**. To transmit the beacon at 10-second intervals, for example, give the command

cmd:**BEACON EVERY 1**

The beacon function also has a transmit-after mode, enabled by using the keyword **AFTER** in place of **EVERY**, in which a beacon packet is only transmitted after activity is heard on the channel. This feature might be used to leave an announcement for other packet users. If someone transmits on an otherwise idle channel, a beacon can be sent a short time later. No beacons are sent in this mode if there is a lot of packet activity on the channel, since the required period of quiet will not occur.

Unattended Operations

Individuals who want to leave their MFJ TNC on overnight can monitor packets even with the terminal or computer off. Just type **CTRL-S** then turn the terminal or computer off. The next morning turn the computer on, then type **CTRL-Q**. The MFJ TNC will dump everything monitored during the night limited only by the amount of available RAM.

The MFJ TNC can operate unattended for extended periods of time. If you would like to have the MFJ TNC operate as a digipeater but not connect with a station, be sure to set **DIGIPEAT ON** and **CONOK OFF**. This is probably most useful when setting up a dedicated digipeater in a remote location.

Packet Formatting

The maximum length of a packet is determined by the command **PACLEN**. If you type more than the maximum number of characters without entering a send-packet character, the MFJ TNC will transmit a maximum-length packet. In Transparent Mode, a packet will be sent if the maximum number of characters is entered before the delay conditions set by **PACTIME** force a packet to be sent. Some MFJ TNCs may not be able to accept packets longer than 128 characters.

If you have set the send-packet character to <CR>, you probably want the <CR> to be included in the packet for display at the other end. If you set the send-packet character to a special non-printing character, you probably want the character to be treated as a command only. The command **CR** controls whether the send-packet character is to be echoed and included in the packet.

You can add a <LF> after each <CR> included in your packets by setting **LFADD ON**. If the other station reports that lines are overprinted on his display, and he can't remedy the situation at his end, you can enable this function.

Commands Affecting Protocol This section describes some of the commands that affect the operation of the packet protocol. Details of the protocol are given in Chapter 9.

The MFJ TNC implements AX.25 Level 2 protocol, a set of rules for formatting messages to other TNCs. The version of AX.25 Level 2 protocol used by the MFJ TNC can be set to Version 2.0 with the command **AX25L2V2 ON**, or to Version 1.0 with the command **AX25L2V2 OFF**. Digipeating may not be successful if some MFJ TNCs are running Version 1.0 and some are running Version 2.0. In addition, the command **CHECK** controls a timing function that depends on the protocol version selected.

You can specify the "address" to be used for unconnected packets, as well as intermediate digipeaters with the **UNPROTO** command. The format is similar to that of the **CONNECT** command:

cmd**:UNPROTO QST VIA NK6K**

The default address for unconnected packets is **CQ**.

The following functions may be useful for tracking down protocol problems. They are seldom useful for ordinary packet operations. The error-checking function of the protocol is disabled for monitored packets with the command **PASSALL**. If you set **PASSALL ON**, any "packet" will be displayed if it

meets the following conditions: It must start with a flag sequence; and it must contain an integral number of 8-bit bytes. The **TRACE** command enables the display of the address and control fields of packets, as well as the text. The trace function displays all bytes in hex as well as ASCII equivalents.

Packet Timing Functions

Transmit Timing

Amateur radio equipment varies greatly in the time delays required in switching from receive to transmit and from transmit to receive. If the MFJ TNC starts sending data before the transmitter is operating or before the receiver has had time to switch from transmitting and lock up on the incoming signal, the packet will not be received properly. The delay between transmitter keyup and the beginning of data transmission is controlled by the command **TXDELAY**. During the time the MFJ TNC is keying the transmitter but not sending data, it will transmit a synchronizing signal (flags).

If you are transmitting packets through an audio repeater, you may require a considerably greater keyup delay than is required for direct communications.

Furthermore, the extra keyup delay is not required if the repeater has not had time to "drop" since the last transmission. The command **AXDELAY** allows you to specify an additional keyup delay to allow the repeater receiver and transmitter to lock up. The command **AXHANG** sets the time the MFJ TNC will assume is required for the repeater to drop. If the MFJ TNC has detected channel activity recently enough that the repeater transmitter should still be on, it will wait only the **TXDELAY** time before sending data, rather than adding an **AXDELAY** time as well.

The commands **TXDELAY**, **AXDELAY**, and **AXHANG** all set times in units of 10 ms. If **AXDELAY** is in effect the total keyup delay will be

Keyup delay = (TXDELAY + AXDELAY) * 10

in milliseconds. If channel activity has been heard more recently than AXHANG*10 ms ago, the keyup delay will only be

Keyup delay = TXDELAY*10

in milliseconds.

Packet Timing

The AX.25 protocol provides for re-transmitting packets if no acknowledgment is heard from the intended destination station within a certain period of time. A packet might not be acknowledged due to channel noise or "collision" with another packet transmission, and since there may be other stations on the channel, the receiving station may not be able to acknowledge the received packet immediately. The time lapse before the originating station re-transmits the packet is set by the command **FRACK** (frame acknowledge time). The maximum number of re-transmissions before the originating station terminates the connection is set by the command **RETRY**. The maximum number of transmissions of a packet is RETRY+1, since the initial transmission does not count as a re-transmission. Setting **RETRY** to 0 specifies an infinite number of retries.

The frame-acknowledge time is automatically corrected for the additional time required for digipeating. The time interval before MFJ TNC re-transmits an unacknowledged packet is

Retry interval = FRACK * (2*n + 1)

in seconds, where n is the number of digipeaters in use for this connection.

Acknowledgments of digipeated packets are made from end to end, and digipeaters do not acknowledge the packets they relay. If there are several intermediate relays, the chance of either the original packet or the acknowledgment to be lost increases drastically. To reduce this problem, an automatic wait time can be imposed on any station not transmitting a digipeated packet. Stations waiting for a clear channel to transmit packets wait for this time interval after the channel clears before transmitting. This wait does not apply if the station will be transmitting one or more digipeated packets. This usually gives the digipeater a clear chance at the channel.

The wait time is set by the command **DWAIT**, which specifies 40 ms intervals. If no digipeating is being done by anyone in the local area, this parameter can be set to 0, but in any event it should be set to the same value by all members of a local packet group.

In order to avoid unnecessary packet retries, the MFJ TNC implements a collision-avoidance strategy which applies to all packets except those being digipeated. On the second and subsequent transmissions of a particular packet, the MFJ TNC waits an additional random time after detecting a clear channel

before beginning transmission. This prevents repeated collisions of transmissions by the same two stations. The random time is a multiple (0-15) of the TXDELAY time.

The interval, in milliseconds, between the MFJ TNC detecting carrier-drop and beginning to transmit is

Wait time = DWAIT * 10

for the first transmission of a packet. For subsequent transmissions of the same packet the interval is

Wait time = DWAIT * 10 + (r * TXDELAY) * 10

where r is a random number from 0 to 15. Thus, if your MFJ TNC is forced to re-transmit packets, you will occasionally hear a fairly long delay before transmission begins.

Multiple packets may be transmitted before waiting for an acknowledgment. This permits more efficient channel use when large amounts of data are being transferred. The maximum number of packets which the MFJ TNC will send before waiting for acknowledgment is specified by the command **MAXFRAME**. This does not mean that t(e MFJ TNC will wait until several packets have been entered before transmitting. **MAXFRAME** in combination with the command **PACLEN**, which sets the maximum number of characters in a packet, determines how much information can be sent in a single transmission. The best combination for efficient data transfer is determined partly by the channel quality and partly by the rate at which the terminal can process data. For a 1200 baud terminal data rate, you should start with a combination that produces about 300 characters outstanding at one time.

Radio Baud Rate

The radio data transmission rate is selectable for 300 baud and 1200 baud. High speed modem such as the MFJ-2400 and MFJ-9600 modem, if installed, can also be selected with the dip switch on the back of the TNC.

Note that there is no relationship between terminal baud rate and radio baud rate. In order to communicate with another packet station you must use the same radio baud rates. The length of time required to send a given amount of information increases as the baud rate decreases. For example, it takes four times as long to

send data at 300 baud as at 1200 baud. If you use slow radio baud rates, you should limit the length of transmissions by setting **MAXFRAME** to 1 and choosing **PACLEN** so that the hardware watchdog timer does not disrupt your transmissions and channel traffic is broken up frequently.

The Bell-202 compatible modem is optimized for a 1200 baud radio data rate. The on-board modem is not useful at rates higher than 1200 baud. The MFJ TNC can provide data signals up to 9600 baud, but an external modem is required for operation above 1200 baud. Optional 2400 bps PSK and 9600 baud modem boards are available from MFJ Enterprises, Inc. These high speed modem boards can be installed inside the MFJ TNC. When an optional modem board is installed and when it is in selected to operate the **TURBO** LED on the front panel of the MFJ TNC will light. Contact MFJ Enterprises, Inc. for more detail. For installation of an external modem, see **APPENDIX F** in this manual for more details.

Special Protocol Times

You can set up a connection time-out with the command **CHECK**, which specifies a time in multiples of 10-second intervals. This function prevents the MFJ TNC from getting stuck in a connection when the other station disappears for longer than the specified time. The MFJ TNC uses this time somewhat differently depending on the setting of **AX25L2V2**.

The command **RESPTIME** sets a delay between the receipt of a packet and the transmission of the acknowledgment packet. This delay is used to prevent collisions between an acknowledgment and another packet from the sending station. This is primarily necessary during file transfers; otherwise the delay is best set to 0. During file transfers the stations receiving the file should set **RESPTIME** to 10 or 12 (default).

The timing of packet transmission in Transparent Mode is determined by the command **PACTIME**. You can choose the way packet transmission is timed. If you are typing input to a remote computer it is usually best to have packets transmitted at regular intervals. If your computer is operating a remote-host or bulletin board program you should send packets after an interval with no further input from the computer. You can enable the use of **PACTIME** in Converse Mode with the command **CPACTIME**.

Monitor Functions

The MFJ TNC's protocol is designed for setting up "circuits" between two stations. However it can also operate in a mode more suitable for a "net" or "round-table" discussion with several participants, although reliable reception of all transmissions by every station cannot be guaranteed. This is done by enabling the monitor functions. Most of the monitor functions are described in Chapter 4.

Monitoring is enabled by the command **MONITOR ON**, and separate monitor functions are individually enabled.

If connected packet QSOs are taking place on the frequency of your group conversation, you may wish to ignore all connected packets while your group operates in unconnected mode. The command **MALL OFF** causes the MFJ TNC to ignore connected packets.

If you want to be able to monitor packet activity when your station is not connected, but have all monitoring automatically cease when you connect to someone, set **MCON OFF**.

If you want to monitor stations selectively, you can set up a list of up to eight callsigns with the command **LCALLS**. The callsigns in this list are regarded as "buddies," i.e., the only stations you want to listen to if **BUDLIST** is **ON**. Otherwise, the stations in the list will be ignored, and all other stations will be monitored.

You can operate a group conversation with some data integrity by having the stations connect in pairs and setting **MALL ON** and **MCON ON**. This does not insure that every packet is received at every station, but it does insure that a packet involved in a collision will be retried. If you have an odd number of stations participating in this sort of conversation, one station can connect to himself via another station as digipeater.

or example, WB6YMH, WD0ETZ, WA0TTW, W1BEL, and K9NG wish to carry on a group conversation. In order to make all the transmissions as reliable as possible, the following connections are made.

WB6YMH connects to W1BEL
WA0TTW connects to K9NG
WD0ETZ connects to WD0ETZ via W1BEL

If each station specifies **MCON ON** and **MALL ON**, each station will see the packets sent by all the others.

Ordinarily, only text packets are displayed. If you want to see some of the protocol packets, you can set **MCOM ON** and connect, disconnect, disconnect acknowledgments, and DM (connect-request rejection) packets will be displayed. For example,

WB9FLW>N7CL <C>
KV7B>N2WX <D>

indicate connect and disconnect packets. Disconnect acknowledgments are designated **<UA>**, and DM packets are **<DM>**.

You can cause the MFJ TNC to "filter" certain characters from monitored packets with the command **MFILTER**. This allows you to remove, for example, form-feeds, bell characters, or extra <LF>s that may be necessary to the stations involved in a connection, but which may interfere with your display. You can specify up to four characters by giving the ASCII character codes in hex or decimal.

Real-Time Clock and Time Stamping

You can enable the MFJ TNC's real-time clock by setting the date and time with the command **DAYTIME**. Once you have set the clock, you can request the time by entering **DAYTIME** with no parameters. The format of date and time display is controlled by the command **DAYUSA**. If the MFJ TNC is powered off, **DAYTIME** will have to be reset.

An optional Real-time clock module (MFJ-43) may be installed inside your MFJ TNC to keep the TNC clock running when the TNC is powered off. With this clock module installed you will no longer need to reset the TNC clock. Contact MFJ or MFJ dealer for information on the MFJ-43 TNC real-time clock.

Monitored packets can be time-stamped if **DAYTIME** has been set. To enable this function, set **MSTAMP ON**. You can also time-stamp connect and disconnect messages with the command **CONSTAMP ON**.

Multi-Connect Guide

Multiple connection capability is a very powerful addition to the MFJ TNC It is very useful for traffic net operation, multi-user bulletin boards, path checking and so forth.

Multiple connection operation is not the same as multi-way operation. With multiple connect, you may establish several point-to-point "links" with various stations. Multi-way, which is not available, would enable multiple stations to be simultaneously interconnected to each other, with each station seeing all data passed from any station in the group, error free.

Multiple connection operation is another step on the road to proper networking, and networking should eventually allow multi-way operation.

Setting the MFJ TNC to Normal Operation

The MFJ TNC defaults the multi-connection-related commands to the following parameters:

CONPERM OFF

STREAMCALL	OFF
STREAMDouBLe	OFF
STREAMSWitch	|
USERS	1

This sets up the MFJ TNC to act just like a "normal" TNC does, that doesn't support multiple connections. The key to obtaining this traditional operation is to set **USERS 1**.

How to Invoke Multi-Connect?

If **USERS** is not **1**, you are telling the MFJ TNC to allow multiple connections to your stations from other stations. In addition, **TRANSPARENT** mode will operate differently, in that incoming data will be prefixed with the current **STREAMSW**itch character and identifier (such as "|A"). Thus, truly transparent operation is not possible with this software release supporting multiple-connections.

The **STREAMSW**itch character, defaulted to "|", should be set to a character you won't normally use. Note that this character may be set to a hex value between $0 and $FF. This may allow you to use 8-bit characters (**AWLEN** 8) if your terminal or computer is capable of generating such "characters." This could help prevent confusion in interpreting incoming data from other stations if they happen to send data that includes your selected **STREAMSW**itch character.

Although not fool proof, enabling **STREAMDBL** may also help in sorting out **STREAMSW**itch characters included in the received data from a valid stream switch generated by the MFJ TNC.

STREAMCAll should be especially helpful when manually operating a station in which you allow multiple connections.

When in **CONVERSE** mode, you may switch streams by entering the **STREAMSW**itch character (default "|"), followed by a stream identifier ("A" through "J"), followed by the data you wish to send to the station on that stream. See the example in the description of **STREAMCA**ll for an illustration of this.

If all this seems a bit confusing, don't worry, it is! The only way to really understand multiple connect operation is to try it! Tested and on-the-air, Once

you have gained confidence in "normal" packet operation, try setting **USERS 2** and get a couple of friends to connect to you. Play with the commands (you can't hurt the MFJ TNC by issuing commands to it!) and see their effects.

Easy-Mail Mailbox

The Easy-Mail mailbox feature is only valid for the HF and VHF packet mode. The operation of the Easy-Mail mailbox is quite simple. There is a command in the MFJ TNC called **MAILBOX**. Being as the **MAILBOX** command in your MFJ TNC is already turned on, makes your Mailbox ready for use, as soon as your MFJ TNC is powered on. Anyone who operates AX.25 packet can access your mailbox by establishing a connection to your station by using the standard packet **CONNECT** command. Once the connection is made, he can send a message, obtain a list of the messages in your mailbox, read the messages or kill any messages addressed to him.

The Easy-Mail mailbox in the MFJ TNC provides approximately 8K bytes of memory for message storage. However, you can increase the mailbox memory on your MFJ TNC to 32K, 128K or even an enormous 512K by simply replace the mailbox RAM chip on the MFJ TNC motherboard. This additional memory is also battery back-up by the lithium battery on the MFJ TNC mother board. Addition memory chip can be purchased separately from MFJ Enterprises, Inc. and it can be easily installed by the user inside the MFJ TNC. Order MFJ-45A for 32K, MFJ-45B for 128K RAM IC or MFJ-45C for 512K RAM IC. The number of slots and space available for each memory size are as follows:

Memory Size	# of Slots	Bytes Avail.
32K	99	32,000
128K	99 per Bank	128,000
512K	99 per Bank	512,000

Set Up your Easy-Mail Mailbox

The MFJ Easy-Mail Mailbox can now be operated independently from the standard packet operation. There are certain commands which need to be set. These will be explained later in this instruction.

NOTE: Whenever **<CR>** is found in this instruction this means to press the **RETURN** key, not to type **<CR>**.

1. Under the cmd: prompt, type:

MYMCALL n <CR>; where n is the callsign you wish to for your mailbox.

2. Type:

USERS 1 <CR>

3. If you want your messages time and date stamped, then set **DAYTIME** with the current information.

Note: An optional TNC real-time clock (MFJ-43) for the MFJ TNC is available from MFJ Enterprises. With this real-time clock module installed in your MFJ TNC, the clock will continues to keep time even with the MFJ TNC turned off. You will not have to set your MFJ TNC's "DAYTIME" every time your MFJ TNC is powered up.

4. Type:

MAILBOX ON <CR>

Now your MFJ TNC is ready for simultaneous Mailbox/Packet operations. You as the SYSOP can access your Mailbox by typing:

SYSOP <CR>

Your MFJ TNC will respond with:

```
|K[MFJ-2.0-M$]
Mailbox ready
 n free Mailbox (B,E,H(elp),J,K,L,M,R,S,T) >
```

First of all lets find out what the **n free** is for. The **n free** is a "Bytes Free" indicator. This applies only to the Mailbox. This is a great feature, because all users will always know how much space is left in your Mailbox. The Mailbox will update the "Bytes Free" whenever messages are forwarded, added or deleted.

Now you are ready to operate your mailbox. However, lets take first things first. You very well cannot operate the Mailbox without knowing the functions of the

commands. So, lets take a look at the functions of the Mailbox commands. The functions are as follows:

B Logout: This initiates a disconnect sequence from the Mailbox.

E Edit Message Header: This allows editing of the message header. This is necessary for the Forward and Reverse Forward functions of the Mailbox. The current is first displayed, then the Mailbox gets the new values, according to what is entered at the prompts it gives the user. The local and remote SYSOPs may edit any messages in the Mailbox. Remote users may only messages TO and FROM himself, and any message of 'T'raffic. Below are the edit prompts and an explanation as to what their functions are:

To: The callsign of the person the message is going to goes here. It must be different than MYcall or MYMcall.

@: The callsign of the BBS you wish to Forward the message to is placed here. This BBS should be the one where the person whom you are sending the message to gets his mail.

From: The callsign of the person who originated the message is placed here.

Type: The Type of message you are sending is placed here. This will turn on a flag in the first flag box. There are a few message types, and here are a couple listed below:

1. "T" messages -- These are **NTS (National Traffic System)** type messages. This message system was developed by the ARRL. These messages must be formatted in a certain way. Please refer to the **ARRL Net Directory** for more detailed view and information on this message system.

2. "P" messages-- These types of messages are still private to the sender, recipient, and the SYSOP.

There are other types of messages supported by the Mailbox but without special features.

Flag: The message Flag is now very important. All of flags can be set via the S (send) or E (edit) commands. This flag will either be an N or a Y. This

will appear in the flag block closest to To: block in the message header. There are different types of flags are as follows:

N Messages with this flag set are all able to forwarded, providing all other criteria is met for a message to be forwardable). Only messages with the N flag set, trigger the "You have new mail!" message.

T The T flag indicates that the message is an NTS message.

Y Messages with the Y flag set are eligible to be killed by the "K" global kill command.

F This flag is set when a message is forwarded. Messages which are eligible to forwarded are:

1. Messages where the N flag is set.
2. Messages that have no @ addresses that are different from MYMcall.

P Messages with this flag set are private to the sender, recipient, and the SYSOP. Only the person to which the message is addressed to can read or kill it. The local or remote SYSOP can read or kill any message in the system.

Here is an example of a Mailbox message with a Type flag and a message flag inserted:

Slot:1 PN To:KB5JNZ From:KF5C BBS Bulletin

The P is in the Type flag block, which indicates that the message is a Private message. The N is in the Message flag block, which tells you that the message has not been read by the callsign KB5JNZ. When KB5JNZ reads the message the N flag will become a Y flag.

H(elp) This command displays the Mailbox command list. A brief description of the commands available to user is given.

J This command replies with the TNC's MHeard list. The eleven most recently heard callsigns will be displayed. The "J" command only applies to remote users.

K Allows you to kill messages which are addressed to you. This works in conjunction with the Y flag. In order to perform a Global Kill, first of all of the messages to be killed during this must have the Y flag set in the header. Secondly, all messages to be killed must have the same callsign as MYMcall.

K## Allows you kill the message in slot nn, where nn is a particular slot number. Remote users may only kill messages which are addressed only to them or originated by them. The local and remote SYSOP can kill any messages, depending on the setting of the new command REMsysop. Please refer to the REMsysop for more detailed information.

L This command allows the remote user, local or remote SYSOP to list all messages in the mailbox. All of slots which are currently in use will be listed. They all will have the slot number, flag field, the destination callsign, originator callsign, subject field. Also the Mailbox command line will be on the next line.

M This allows the remote user, local or remote SYSOP to change memory banks in the mailbox ram. The current memory bank is indicated on the mailbox command line. The bank will be inside a pair of{}, which will be after the "bytes free" indicator. Below is an example of a typical command line from the mailbox:

nn free {n} Mailbox (B,E,H(elp),J,K,L,M,R,S,T) >

Where {n} is the bank number. The bank number will vary from 0 to 7 depending on the size of the expanded memory ram. The bank numbers in relation to the RAM size are as follows:

MEMORY SIZE	BANK NUMBER
32K	0
128K	0 or 1
512K	0 thru 7

NOTE: There will be only one (1) number in the { } at anytime.

For example let's say that you are running a 128K mailbox, and a remote user wants to access memory bank #1. First a connection to your mailbox must be made. Once the Mailbox command line is obtained the user will type:

M 0 <CR>

This will be received by your Mailbox and then your Mailbox will send back a new Mailbox command line:

nn free {0} Mailbox (B,E,H(elp),J,K,L,M,R,S,T) >

Thus the {0} indicates the memory bank has been switched to bank #1.

NOTE: The "M" function applies only to an MFJ TNC which have expanded mailbox memory.

R This command lets you read messages addressed to you. When you list the messages in the mailbox you notice an N flag next to the messages which you have not read. Once you read those messages the N flag will change to a Y flag. This is an indicator to both you and the SYSOP that the messages have been read. From there you can perform a global kill on all of your messages or the SYSOP can kill them individually.

NOTE: The only way an N flag can get changed to Y flag during a read is that the person who the message is addressed to needs to read it. The flag will not change for any other person who reads the message.

R## Allows you to read the message in slot nn. Where nn is a particular slot number. This command works the same as the R command, except its for reading the individual slots.

S call This allows the remote user, local or remote SYSOP to send a message to the designated callsign. "CALL" must be a callsign valid under the same format as the MYCALL, CONNECT or other callsign commands. You can also send messages in NTS (National Traffic System) format. You will need to refer to the ARRL NET DIRECTORY for more detailed information on the NTS system.

SP call This allows the remote user, local or remote SYSOP to send a personal message to the designated callsign. This is a private message and only the person to whom the message is addressed can read or kill it. The SYSOP can also read the private messages. When a private message is listed a P flag is shown in the "Message Type" flag block. The P flag can also be inserted by the originator or the SYSOP through the Edit command.

T This command allows the remote user to page the SYSOP. When the T command is invoked from the remote user the following message appears on the SYSOP's computer screen and it also is sent back to the remote user's screen:

Paging SYSOP; any key aborts

The Mailbox will page the SYSOP by ringing the SYSOP's terminal bell 30 times. If the SYSOP is at his or her terminal, the asterisk character will appear on the screen every time the terminal bell (CTRL-G) rings. If the SYSOP does not answer the Mailbox will send the message back to the user saying no answer. Below is an example of a typical screen:

Paging SYSOP; any key aborts...
**********************************No answer**

The remote user may abort the SYSOP page by sending packet to the Mailbox. If the SYSOP does answer the page then the SYSOP can enter CHAT command, then converse one-on-one with the remote user.

This concludes the explanation of the commands which are on the Mailbox command line. Now lets get into a little of the Mailbox operation. If you have any questions about the Mailbox commands, we believe they will be answered in this section.

Mailbox Operation

1. First establish a connection to the Mailbox station.

2. If the Mailbox of the station to which you are trying to connect with is ON, then it will answer back with the Mailbox prompt:

Mailbox Ready

nn free {n} Mailbox (B,E,H(elp),J,K,L,M,R,S,T) >

Note: The nn free indicates the amount of RAM space available for messages in the Mailbox to which you are connected to. The nn will be no higher than 65K, if a 512K or a 128K Mailbox is in operation. If the Mailbox is 32K then nn will be 32K.

Note: The{n} indicates the memory bank being used for the Mailbox. Please refer to the explanation of the M command for the Mailbox, in this section.

Now at this point all of the Mailbox are available to you. You may then type M to switch the memory bank of the Mailbox, K to kill a message, L to list all messages, R to read the messages, S to send a message, B to logout and disconnect from the Mailbox or H for the HELP menu.

3. To send a message the S or the SP commands must be used. It must be used in conjunction with a callsign as in the examples below:

S KB5JNZ <CR>, this will send an ordinary message to the callsign KB5JNZ.

or

SP KB5JNZ <CR>, this will send a private message to the callsign KB5JNZ.

The Mailbox will respond with:
Title:

_

The user will enter the message subject (title) at cursor prompt, then press the "RETURN" key.

The Mailbox will respond with:
Send msg; Control-Z or /EX to end:

_

The user will then enter the message at the cursor prompt. If you are using a 512K or 128K Mailbox then you can actually upload disk files into the Mailbox. The 32K version has the same capability but with 32K RAM capacity. At the end of the message press a Control-Z and the RETURN key. The message will be sent.

Your message will be seen on the mailbox station's screen, then the mailbox will respond with the mailbox command prompt:

nn free {n} Mailbox (B,E,H(elp),J,K,L,M,R,S,T) >

Where nn is the "bytes free" indicator. This tells the user how much ram space is available in your Mailbox. Also {n} is the indicator of the current memory bank in use by the Mailbox.

4. There are two (2) different ways to kill messages. The first is give in the example below:

I. To kill a message in a particular slot type:

K## <CR>

Where the ## is the message number you want to kill.

The Mailbox will respond with:

Message ## deleted;
nn free {n} Mailbox (B,E,H(elp),J,K,L,M,R,S,T) >

This is whether or not the message flag is set to an N or a Y. Note that the remote users may only kill messages which are addressed them. The originator can also kill the message. The local SYSOP can kill any or all messages in the Mailbox.

II. You can perform a Global Kill on a group of messages which are under the same callsign. To perform this two (2) conditions must be met:

a. All messages must have been read and the message flag must be a Y.

b. The callsign contained in the MYMcall must be the same as the callsign in the MYcall command.

If the above conditions are met then all the user must type:

K <CR>

This will go out to Mailbox, then the messages with the message flags set to Y and all of the proper callsigns will be killed. The Mailbox will respond back to the remote user with all message numbers killed during the Global Kill process. Also the Mailbox prompt will be given again. The "bytes free" indicator will be updated also. The SYSOP either remote or local can do a Global Kill. The SYSOP must individually kill any messages.

5. The remote user or local SYSOP can List messages from the Mailbox. In order to do this first the Mailbox prompt must be obtained by either a connection to the Mailbox or through the local SYSOP command. Then to List messages from the Mailbox:

A. Type:

L <CR>

B. The Mailbox will respond with a list of currently used slots in the following format:

Slot:## To: From: Subject:

Where Slot## column is the number of the slot which the messages are in. The lower case t is the **Type Flag** block. The lower case m is the **Message Flag** block. The To: column will contain the callsign of the person who the message is addressed to. The From: column will contain the callsign of the person who left the message. The Subject: column will contain a brief message title.

Note that the number of slots for an MFJ TNC without expanded memory is 30. For an MFJ TNC with the expanded mailbox memory installed the maximum slots per memory bank is 99.

After the Mailbox lists all messages it will issue the Mailbox prompt:

nn free {n} Mailbox (B,E,H(elp),J,K,L,M,R,S,T) >

6. Anyone who accesses the Mailbox can read messages or which are addressed to him/her. Also a message which is a addressed to ALL, such as bulletins can be read by anyone. Messages can be read by two (2) different methods. Below are the two methods:

A. This method will allow the remote user, local or remote SYSOP to read a group of messages. This is only good for a group of messages with the same callsign as MYcall. The set conditions of the Type or message flags have an effect on a read process. They can be set to an N, Y or an F. To perform this type:

R <CR>

B. Messages can also be read individually by the slot number. This is good for reading other messages like bulletins or messages addressed to ALL. In order do an individual read type:

R## <CR>

Where ## is the slot number of the message that you wish to read.

C. The Mailbox will respond with the message from the slot specified.

All messages read will be in the following format.

Slot## To: From: Subject:
This is an example of a message from the Mailbox

Where Slot## column is the number of the slot which the messages are in. The lower case t is the **Type Flag** block. The lower case m is the **Message Flag** block. The To: column will contain the callsign of the person who the message is addressed to. The From: column will contain the callsign of the person who left the message. The Subject: column will contain a brief message title.

Then at the end of the message the Mailbox prompt will be issued.

7. The remote user can also disconnect from the Mailbox without having to issue a CTRL-C, D and a RETURN. All that needs to be done is to type: **B** to logout of the Mailbox and disconnect from the it. If you access your Mailbox via the SYsop command, then you must issue a CTRL-C to exit the Mailbox and return to command mode. The command prompt will indicate the stream you are on. The command prompt may look like this:

|Acmd: where |A indicates that you are on packet stream A.

This is the only way the remote users can access your Mailbox. If you stay in the SYSop mode then when a user tries to connect to your Mailbox he will a message like this:

***CALLSIGN Busy**
Disconnected

The SYSOP will receive a message like the example below when he is in the SYSOP mode and someone tries a connect:

***connect request:CALLSIGN**

Additional Mailbox Features

Other MFJ TNC mailbox features are as follows:

Forwarding
The MFJ TNC Mailbox now has the ability to Forward mail to most full service and personal mailboxes. This feature allows you to compose your mail on your TNC, at your leisure, and then Forward the resulting messages for eventual delivery.

Messages may be forwarded any one of three ways either manually, by command, or by automatic forward. You can either forward messages hourly, or by your local full-service mailbox's reverse forward request.

Manual and hourly forwards may proceed through up to eight (8) digipeaters, allowing the messages to be forwarded through ROSE switches. Also NODE forwarding is can be done too, thus allowing you to forward mail through NETROM, THENET, and KA- NODE switches. Please refer to the **NOD**eforw command in this manual.

In order to conserve RAM, space the SYSOP may specify that forwarded messages be killed upon successful forwarding. However, if conserving RAM is not a concern, then forwarded messages will be flagged "F". This flag will appear in the message flag block. Messages with F flags will be saved in the mailbox for the SYSOP's disposition.

All forwarding events are monitored on the screen, in order to inform the SYSOP of the forwarding progress.

In order for a message to be eligible for the forwarding process two (2) conditions must be met:

1. Messages must have N flags in the message flag block.

2. All messages must have an @ callsign in the message header.

The command used to forward a message is **FO**. All forwards must be done in the stream cmd:mode. This command is by pressing a CTRL-C while in the SYSOP mode. Below is a typical example as to how to use the FO command:

FO CALLSIGN <CR>

Where CALLSIGN is the callsign of the destination mailbox. This callsign must also reside in header of the message to be forwarded. The message header can be

altered through the Mailbox Edit command. Please refer to the EDIT command in this manual. When the FO CALLSIGN is issued the MFJ TNC will initiate a connect request to the destination BBS. If the connection is successful the your mailbox will proceed to send the message to the destination BBS.

Eliciting Reverse Forwards

This very unique feature, when combined with the hourly automatic forward, enables the MFJ mailbox to query another BBS, regularly and automatically, for the purpose of polling the other BBS for the TNC user's mail. Thus, even if your local full-service BBS operator is unwilling to forward to you, you can still have most of the benefits of auto-forwarding because your own TNC will elicit your mail for you on an hourly basis.

Reverse forwards may be restricted to a particular callsign. This prevents others users from "stripping" messages off of the mailbox prior to their being forwarded to the legitimate destination.

When all messages are forwarded, if the destination mailbox supports reverse forwarding (as determined by $ in it's SID) then the MFJ TNC will attempt to elicit a reverse forward.

Remote Heard Log

This handy feature allows the remote user to query the TNC heard log at any time. From this log the remote can determine band conditions, or just see who has been around. The log holds eleven (11) of the most recently stations.

Chat Mode:

The Chat mode feature in the MFJ TNC Mailbox is similar to the standard TNC "converse mode". It enables the SYSOP to break onto a mailbox link, and get one-on-one with mailbox user. This is just like a regular "Packet QSO". This is good for discussing problems maybe with the link or with the mailbox in general. Chat mode terminates any user or forwarding operation in progress. The mailbox will stay in Chat mode until the SYSOP returns to command mode.

Page SYSOP

This allows the remote user to "Page" the SYSOP by ringing the SYSOP's terminal bell. This is done by the SYSOP's mailbox sending a CTRL-G to the

SYSOP's terminal. The SYSOP's mailbox will poll the terminal's bell 30 times. If the SYSOP does not answer the remote user will receive a message back saying No Answer. If the SYSOP does answer then he can go into the Chat mode, and converse with the remote user. For more detailed information on this feature please refer to the section on Mailbox Set Up in this manual.

Remote SYSOP

The Mailbox has the capability to be remotely controlled. A callsign can be specified by the SYSOP for this purpose. This would be useful in the case where the SYSOP is out in the field. It would allow him to control the mailbox, and do most of the local SYSOP's duties, such as killing messages, reading, editing message headers for forwarding purposes.

Mailbox CText

This is a message dedicated to the Mailbox, but is used when a connect is made to the MYMcall callsign. It is limited to 120 characters in length. If MCText is empty, then no message will be sent.

Idle Timeout

The Mailbox incorporates an idle timeout function. This is to ensure that the mailbox is still accessible in the event of a remote user drop out during a connection or walks away from the TNC for too long. The Mailbox will automatically do a disconnect from the link after the time which the SYSOP specifies.

Abort:

This command gives the SYSOP control over the mailbox by allowing him to force a disconnect on the mailbox link. It may also be used to avoid any QRM, to abort a forward-in-progress. You can also use it to terminate mailbox usage by an unwelcome user.

The new Mailbox system is fully compatible with NTS packet messages also. It allows you to format NTS type messages, and send them to another destination.

The MFJ TNC also incorporates a new "bytes free" counter. It is updated as the mailbox fills or empties. It keeps up with the available RAM in multiple memory banks.

The Mail waiting is indicated by the flashing of the STA/MAIL LED on the front of the MFJ TNC.

The STA/MAIL LED of the MFJ TNC serves two functions. It lights when unacknowledged packets are pending during a packet connection. If you have mail waiting, the STA/MAIL LED will flash on and off if the MFJ TNC is not connected to another packet station.

The "mail-waiting" LED function can be disabled by using the MAILLED command. MAILLED is defaulted to ON. When MAILLED is OFF or when MFJ TNC is in a connected state, STA/MAIL LED will not flash.

Mailbox Messages

You have mail!

Upon access to a mailbox, this message will appear if there are messages addressed to you.

?EH

This message occurs when a command issued is not understood by the mailbox. This could be out of range slot number, missing slot number where one is required, or bad command.

Cannot, not yours

This message occurs when a remote user attempts to kill a message which is not his, or he tries to read personal message by or for someone else.

?Mailbox full

This message occurs when either all of the available slots are full, or the actual message space is full. Messages must be killed to recover from this error.

Not found

This message occurs when one attempts to read or kill a non- existent message from an empty slot.

None found

A parameterless Kill or Read command did not find any messages addressed to the user.

No mail

A parameterless read command did not find any mail addressed to user or due to mailbox being empty.

Slotting and Acknowledgment Priority

The **SLOTTING AND ACKNOWLEDGMENT PRIORITY** feature is installed in the MFJ TNC in an attempt to prevent or minimize packet collisions in a busy channel.

Use of the optional SLOTTING and ACKNOWLEDGMENT PRIORITY procedures now in the MFJ TNC firmware significantly improve the reliability of packet radio connections on shared channels. The greatest improvement is yielded when all stations in a network are so equipped and configured with the appropriate, matching parameters.

SLOTTING improves channel efficiency by requiring each TNC to "flip" a many sided die whenever the channel goes from busy to not-busy. The result of the "flip" is the number of 10ms DEADTIME intervals the TNC waits before transmitting.

SLOTTING solves most of the problems that occur when there are two or more stations waiting to transmit when a third is already transmitting. Before slotting, the first two stations are definitely going to transmit at the same time, guaranteeing a collision. With slotting, the first station will probably choose a "slot" different from the second. If everyone is hearing everyone else, collisions are very unlikely.

In conjunction with slotting, the ACKNOWLEDGMENT PRIORITY feature helps improve channel utilization by assigning priority to acknowledgments (AX.25 frame types "S"), i.e. acknowledgments are never delayed by slotting.

The reason this works is because each TNC recognizes when another is transmitting. It also recognizes the destination of each packet it hears. If a TNC hears a packet not addressed to it, it can assume that somewhere another TNC will send an acknowledgment. Therefore, on hearing packets for others, a TNC will always wait at least one slot time in case the addressed TNC acknowledges. And it will never delay it's own acknowledgments.

Description

The idea behind the prioritized acknowledgment (ACK) protocol is quite simple. The idea is to give ACKs priority access to the channel so that time is not wasted retrying packets that have already been correctly copied but for whatever reason, the ACK is not received within the time limit defined by the FRACK timer.

The present protocol does not handle a simplex LAN with hidden terminals as well as it possibly could. This is primarily because, the present protocol is more likely to synchronize collisions with acknowledgment packets than with any other type of packet.

To this collision synchronization mechanism the current version of AX.25 adds a propensity to cause even ACKs which are not from hidden terminals (& therefore less susceptible to collision) to be delayed beyond even generous FRACK timer settings when the channel gets busy.

Once the FRACK timer times out, even if the ACK finally makes it through before the retry is sent, the original packet is retried anyway. This obviously wastes a lot of time which could be better used clearing the channel of some of the legitimate offered load.

It is this feature of the current AX.25 protocol that accounts for most of the abysmally poor performance of the currently popular NETROM and THENET nodes when they are used as omnidirectional single channel (or even multichannel if there is more than a single other node on each channel) systems. It should be noted that these node chips CAN handle point to point links to a single other node perfectly adequately.

The prioritized ACK protocol avoids the above problems by giving ACKs priority access to the channel. It does this in such a way that even ACKs coming from hidden terminals are protected from collision.

The current protocol gives a limited version of this priority access only to digipeated frames. Although it will be possible to support digipeating in a compatible (with the new protocol) fashion, compatible digipeating support was not an objective that was addressed in this release.

Ack prioritization works with slotted channel access in the following way:

1 Response frames (ACKs) are always sent immediately with no time delays unrelated to hardware limitations applied. Ultimately, not even DCD will be

checked for sending an ACK. However, in this release DCD will still hold an ACK off the channel.

2 Stations queued up to access the channel but waiting for a channel busy condition (DCD true) to clear, will start a slotted access procedure only AFTER enough time for a response frame to clear the channel has transpired (weather or not the response frame is detectable by the queued up station).

3. Slot time windows are selected to be large enough that the local TNC will be able to unambiguously determine whether any other detectable station has selected any slot, preceding the slot selected by the local TNC.

This is to prevent two TNCs which have selected adjacent slots from colliding.

As you can see, under this protocol there will never be a condition where an ACK is delayed from being sent beyond the FRACK timer limitation. In fact, the FRACK timer becomes relatively meaningless in this context. However, in the current firmware release, The FRACK timer is still active and must be set to a value that is long enough to allow time for PACLEN + ACKWAIT to expire before FRACK does. This time will depend on the radio baud rate in use. The TNC knows that if it doesn't see the ACK immediately when expected, it is never going to see it. See discussion of new parameters below for definition of ACKWAIT.

Enforcing a channel access delay for all stations on the channel for whom the packet that caused the queue was not intended (& who therefore aren't going to ACK it) allows even ACKs from hidden terminals to get back to the expecting station. This clears that traffic from the offered load list. If the packet was indeed copied and ACKed, further retrys of the same information will not be necessary.

New Parameters

There are several new parameters that relate to this modification of the protocol. They are as follows:

ACKPRIOR ON|OFF

This enables prioritized acknowledgments if turned on.

If ACKprior is turned off and SLots (see below) is set to 0, this modification of the AX.25 protocol is effectively disabled. The MFJ TNC will behave like normal AX.25 protocol.

Prioritized acknowledgments and slotted channel access can be enabled or disabled independently of one another. So you could if you wished run normal AX.25 with slotted channel access or the new protocol without slotted channel access.

DEADTIME 0 - 250 (each increment represents 10 milliseconds)

This is the time between when a remote TNC has pressed PTT and when the local TNC can reasonably be expected to detect this fact.

This must be set to a value that accounts for the slowest acceptable station on the channel. It includes the time required for the remote station's radio to come on the air properly after assertion of PTT (TXDelay) and the time required for the local station's squelch (if used) and TNC DCD circuits to allow generation of a "DCD true" signal in the local TNC. Ideally, once the proper value for this timer is ascertained, all stations on the channel will use the same value.

Very preliminary testing done here on VHF indicates that measurements of the above delay times should be multiplied by 1.5 for use as the DEAdtime parameter. We had carefully measured the times for all stations participating in our tests. This gave us a worst case delay total of 210 milliseconds. When we ran the test, we were still getting about a 5 percent collision rate on the acknowledgments. We were required to increase the DEAdtime parameter to 30 (300 milliseconds) to completely eliminate collisions with ACKs.

The current default for this parameter is a ridiculously short 30 milliseconds. This represents only the worst case delay for the TNC's DCD circuit and completely ignores the radio delays.

A much more reasonable value for this timer on VHF NBFM 1200 baud AFSK is 300 milliseconds (DEAdtime 3et to 30). This represents a relatively safe time for a radio that is usable for serious packet work.

Most HF linear mode radios are MUCH faster than VHF FM radio. A reasonable setting for HF work is 120 milliseconds (DEAdtime set to 12). This should work fine with virtually any HF radio stable enough to consider using on HF packet.

ACKTIME 0 - 250 (also 10 millisecond increments)

This represents the time required to send a response frame (with no I field appended) at the baud rate being used on the radio port.

The current 100 millisecond default is close but should be adjusted for 1200 baud work to 130 milliseconds (ACKTime set to 13).

For 300 baud HF work this parameter should be set to 520 milliseconds (ACKTime set to 52).

SLOTS n 0<=n<=127

This parameter determines how many sides are on the slot time dice. SLOTS represents an n+1 sided dice the MFJ TNC "throws" before transmitting. The SLOTS command allows any number of slots from 1 thru 127 to be defined.

SLOTS (n)	REMARKS
1	Disables Slotting
2	
4	This should be the default setting
8	Use only if the channel is VERY busy.
16	VERY VERY VERY busy !
32	You get the idea.
64	
128	Might as well print it out & send it in the mail.

The value used on a particular channel should be agreed on by the channel users. Access to the channel will be equitably distributed among all users if everybody is using the same value for the SLotmask and DEAdtime parameters.

The idea is to pick a value large enough that the probability of two queued up stations picking the same value is relatively small. On the other hand, the value chosen should be small enough that most of the time, ONE of the queued up stations will have a significant probability of picking the first available slot. In

this way, the channel is reliably arbitrated and at the same time the overhead required for the arbitration is minimized so that overall throughput on the channel is maintained.

The actual value used will depend on the average number of queued up stations there are on the channel during busy periods.

ACKWAIT (not directly user settable)

This timer actually consists of the sum of the 2 user settable parameters ACKTime and DEAdtime. It represents the time the queued up TNC will wait before transmitting if it has selected slot 0. This allows time for a completely inaudible (to this TNC) ACK to have been sent on the channel without molestation. It was split into two timers because it has two unrelated components. One is related only to the baud rate being used on the channel. The other is related only to the absolute times the hardware requires to transport carrier information from one station to another on the channel.

Other Related Parameters

Several of the existing TNC parameters will affect the operation of the modified protocol. Most of these are parameters in TNCs on the channel which AREN'T using the new channel access procedure. One, FRACK, must be set correctly in any TNC which IS using prioritized ACK protocol.

FRACK should be set to a value which allows time for the TNC to send its packet AND receive the ACK. This value will depend on the settings being used for PACLen and the radio port baud rate. This is because, for some reason which I can't even begin to understand, the FRACK timer starts at the BEGINNING of the packet rather than at the end. For this reason, it is probably best to set FRACK to its worst case value for whatever baud rate you are using on the radio port. This way you can make adjustments to PACLen without having to worry about interaction with the setting of FRACK.

The FRACK settings that should be used (at least initially for BETA testing) are as follows:

BAUD RATE	FRACK (SECONDS
1200	3

300	8

Note that these settings apply when everyone on the channel is running the new protocol. This assumes that all stations on the channel have both DWait and RESPtime set to 0.

If you are running the new protocol on a channel where some of the stations have long RESPtime delays, those stations will not be able to successfully communicate with you after connecting. If you wish to communicate with these stations you will have to set your FRACK timer to a number which is longer than the other stations RESPtime delay.

Both DWait and RESPtime are meaningless in the context of the new protocol. However, in this release both timers are still active and should be set to 0 when using the new protocol.

Initial Parameter Settings Summary

The settings for use at 1200 baud on a VHF FM channel are:

ACKprior ON
SLots 3
DEAdtime 33
ACKTime 13
RESPtime 0 (If you require a nonzero value for this parameter in order to prevent ACKing individual packets in a MAXframe greater than 1 blast, your DCD circuit is not working. Please get it fixed.)
DWait 0 (DWait should be set to 0 even if there are digipeaters on the channel. The new system will not degrade the performance of digipeaters on the channel because the ACKWAIT can be used by the DIGI.)
MAXframe 1 - 7 depending on channel quality
FRACK 3

The settings to use for 300 baud work on a linear mode HF channel are:

ACKprior ON
SLots 3

DEAdtime	12
ACKTime	52
DWait	0
RESPtime	0
MAXframe	1
FRACK	8

What to Expect

This modification to the protocol is compatible with stations using the current protocol in the following respect. A station using the new protocol will not degrade the channel for users of the current protocol. So there is nothing wrong with firing up the new stuff on a channel where the majority of the users aren't yet using it. You will be able to communicate with users of the other system without difficulties.

However, if the users of the old channel access procedures have DWait and RESPtime set to 0, they will tend to hog the channel from users of the newer, more polite access system.

Therefore, for purposes of testing the effect of the new system on channel throughput, if there are stations on channel which are NOT using the new system, they should set their DWait value to one that is compatible with the

new system users. A reasonable DWait setting for 1200 baud use would be 73. For 300 baud work, it would be 76.

While these settings seem extremely long, they will assure that the stations NOT using the new protocol always get a shot at slot #1. With these settings, the users of the NEW protocol will occasionally capture the channel.

Settings of 43 for 1200 baud and 64 for 300 baud could be used to assure that stations NOT using the new protocol always have a shot at slot #0. This will result in users of the new protocol almost never being able to capture the channel unless all traffic from users of the old protocol has been cleared. This should NOT be done unless ALL stations are using some type of slotted channel access procedure with compatible numbers of slots and compatible slot times.

Remember that the objective of the new channel access procedures is to increase aggregate throughput for the CHANNEL, not necessarily for an individual user (not even you!). It may seem to you at first when you get on a very busy channel

where you are the only station that is using the new system, that you aren't getting to transmit very frequently. This is because you aren't getting to transmit very frequently. However, the OTHER users on the channel will see an incremental increase in the overall amount of data that the channel can pass per unit time because you are being such a nice guy. Remember that transmitting isn't necessarily communicating.

There is ONE benefit that you should be able to see even under the above circumstances. If you are communicating with another station who is also running the new system, the channel should appear more reliable to you even if quite slow. You should not be getting retried out waiting for his ACK to come back & have to keep reconnecting.

As a higher and higher percentage of the users on the channel begin using the new system, the performance of the channel should increase quite a bit. However, we all must remember that if a channel is mathematically capable of transferring (for example) 1000 characters per unit time, the very best it can possibly do (if CSMA is working right) is reliably pass about 620 characters per unit time. If it is offered more than this to handle, performance falls off sharply with increased offered load. Currently the typical AX.25 simplex channels observed on the HAM bands tend to hover around 10 to as high as 18 percent throughput. This is far below the 62 percent that is possible when the protocol is working right.

Packet Picture Transfer

The MFJ TNC gives you the unique ability to transmit and receive Packet Pictures. Unlike the binary file transfer ability common to all packet controllers that lets you transmit and receive picture files, MFJ TNC lets you transmit and receive actual packet pictures directly. You can also transmit and receive FAX, SSTV and other graphics formats pictures with the MFJ TNC in the VHF packet mode. Packet pictures received are directed to and printed on the built-in printer port on the MFJ TNC. Any EPSON (tm) or IBM (tm) graphics compatible printer may be used. Packet pictures can also be sent to the computer screen if special software, such as the MFJ-1284, is used.

Receiving Packet Pictures on Printer

Packet pictures data transmitted from the connecting packet station are received and data is sent directly to the printer attached to the MFJ TNC, without any

intervening modification. Therefore, all data MUST use the same printer control codes that your printer uses. Typically **EPSON** format codes will be used.

The **PKTPIX** command provides a method for the MFJ TNC to print packet pictures other graphics-format data transmitted by another station in the VHF packet mode. When you set **PKTPIX**, your MFJ TNC becomes ready to print graphics data.

Using **PKTPIX**

Packet picture printing to the MFJ TNC printer port requires you to first establish a packet connection with the station who is going to send the picture. Note that you won't be able to call up PKTPIX until the connection is made. You must have the printer powered and selected before MFJ TNC will let you use the **PKTPIX** command.

Once these conditions are met, all data received over the packet link are sent directly to the printer. You can exit PKTPIX by using the escape-to-cmd: mode sequence for TRANSPARENT connections. Use CTRL-C three times (default), or asynchronous BREAK.

Packet Picture transfer to the computer screen

Packet pictures can also be received and displayed on the computer screen in real time. To achieve this a special terminal program must be used. The MFJ Starter Pack for IBM and compatible computer includes terminal program, Multicom that allows you to transmit and receive SVGA, VGA, EGA or CGA pictures in real time and display them on the screen. Multicom can transfer binary files in additional to picture files. It also allow you to set up your personal packet pictures bulletin board. Graphics that you create with certain "paint" software, such as QSL cards, drawings and pictures can be saved and transmitted to the connecting packet station with Multicom. Also, pictures created with digitizers, such as the MFJ-1292 "Picture Perfect" video digitizer, can be transmitted and received using Multicom. Digitized pictures may also be "enhanced" with drawing or "paint" software.

Detail HF Packet Operation

Radio Setup for HF Packet Operation

Setting up your Radio interface will follow exactly the same procedure as for VHF NBFM operation with the exception that you will probably not need to set the modem output level. This is because linear mode radios typically have a transmit audio level control on the front panel and an indicator which tells you when you have set the level correctly. You will adjust the audio level just as you would for SSB operation.

If you are using the auxiliary audio input connector (other than microphone input), you MAY need to adjust the transmit audio level from the MFJ TNC modulator. This is because many auxiliary audio inputs are intended for phone patch audio. These levels are typically much higher than microphone levels.
If you do adjust the output level of the MFJ TNC to a relatively high value for this type of application, do not operate the MFJ TNC with a VHF NBFM radio unless you take steps to assure that the audio level for the FM radio will not produce excessive deviation. If both radios are to remain connected to the MFJ-1270C, you can set the audio level for each radio independently by using the audio output level adjustments, R157, on the left side of the MFJ TNC with a small screw driver.

The modem center frequency used by the MFJ TNC for all of the narrow shift AFSK modes including HF packet operation is 2200 Hz (2125 and 2295 Hz tones). Most frequencies listed for packet operations in the HF bands were established using a modem center frequency of 1700 Hz (1600 and 1800 Hz tones) in lower sideband mode. This is a 520 Hz offset (2220-1700) between the two modem standards. So a listed frequency of 7093, for example, will cause you to have a frequency display on your radio of 520 Hz PLUS the listed frequency (IF you are also using lower sideband mode). Thus you should find the 7093 KHz packet activity centered around 7093.52 KHz.

Your tuning indicator (MFJ-1274C only), when properly centered, is easily capable of 10 Hz alignment accuracy. It should be used as the tuning reference on any individual signal regardless of the frequency indicated on the radio dial.

NOTE: The signal actually transmitted by your SSB transceiver (F(emission)) when using the MFJ TNC for AFSK HF packet operation using lower sideband will cover a band of frequencies approximately 400 Hz wide and centered at the transmitter indicated carrier frequency (F(ind)) minus the modem center frequency (Fc).
So you would use:

F(emission) = [F(ind) - Fc]

to determine the actual operating frequency for band edge or netting purposes. Remember to consider that you will be occupying a few hundred Hz on either side of F(emission).

NOTE: Regardless of the type of modem, whether or not the modem has audio filtering built in, 300 baud AFSK modem performance on a High frequency linear mode (SSB as opposed to NBFM) radio channel will NOT be optimum UNLESS a filter of approximately 500 Hz bandwidth is used in the radio IF strip.

There are two reasons why this is the case. First, for the filtering to be fully

effective, it has to precede the first hard limiter in the system. This limiter is typically located in the first stage of the demodulator. Second, no filter at n prevent an off channel interfering signal from capturing the receiver AGC system and causing wide variation in the level of the audio presented to the demodulator. All demodulators are affected by audio level variations.

If a narrow (approximately 500 Hz) filter is to be used in the radio for HF packet and RTTY operation (and this is STRONGLY recommended), it may be necessary to use a tone pair centered on the radio's filter rather than the "standard" 2125/2295 or 1600/1800 Hz pair. If the radio lacks IF shift capability, this will almost certainly be necessary. If this is the case, it will be necessary to determine the center frequency of the audio spectrum output from the receiver when the narrow filter is selected and the radio is in the LSB mode.

Most radios which provide for direct FSK RTTY operation use the radio's narrow CW filter if one is installed. Packet operation using direct FSK is a viable mode but extreme caution should be exercised to make sure TX and RX frequencies are identical and that the transmitted frequency pair is centered in the radio's 500 Hz filter passband. Once the required modem center frequency for the particular radio's FSK mode has been determined, the modem alignment procedure presented in the trouble shooting / calibration section of the owners manual may (should) be used to align the modem for this mode. Since there is no standardization among the various radio manufacturers in this regard, a method for making the determination of transmitter FSK output frequencies and their relation to the LSB carrier oscillator and center of the 500 Hz filter is NOT presented here. Contact the manufacturer of the radio to obtain this information.

Radios which have provision for an auxiliary "narrow SSB" filter can have the 500 Hz bandwidth filter installed instead of the approximately 1.8 KHz wide "narrow" SSB filter. This will allow direct selection of the narrow filter for AFSK work when in SSB mode. If the filter is also desired for CW

operation and you don't want to invest in 2 identical filters, it is usually a relatively simple modification to cause the radio to also select this filter when in CW mode.

Some of the newer HF radios (and many older ones) allow selection of filter independent of mode. For these radios it is a simple matter to select the required mode and the optimum filter independently of one another.

If the HF radio is to be dedicated to packet use, the 500 Hz filter can be installed in place of the SSB filter. This is possible on ANY radio designed for SSB and CW use.

It is important to use lower sideband rather than upper sideband if you are going to use a CW filter in the radio for packet operations. The reason for this is simple. The filter designed for CW operation is usually centered approximately 800 Hz away from the upper sideband suppressed carrier. This is the carrier oscillator which is normally used as the BFO on CW. This means that if the two carrier oscillators are 3 KHz apart, the CW filter center will be near 2200 Hz below the lower sideband carrier. This is the reason 2220 Hz was selected for the center frequency of the modem.

If you are going to use a narrow filter, and serious HF operation is NOT recommended without one, it will be necessary to take steps to be certain that the filter passband is centered over the modem center frequency. If your radio has IF shift, this is a simple matter. The tuning indicator and DCD LED are used to give you an indication of filter centering. The following discussion assumes that your radio has provision for IF shift.

To center your radio passband over the modem, use the following procedure:

1. Set your radio for maximum RF gain.

2. Set the radio for lower sideband operation.

3. Make sure the MFJ TNC is in HF Packet mode and that the HF Packet modem has been selected.

4. Set the audio output level so that the tuning indicator is responding to the background noise coming through the filter. This can be verified by observing whether or not the tuning indicator "follows" the noise as the IF shift control is rotated.

5. Tune to a frequency which has ABSOLUTELY NO signals in the passband. It is very important that only noise is coming through the filter. If you have access to a RX noise bridge, an alternative is to use the bridge as a noise source for the receiver. No antenna is required in this case.

6. Adjust the IF shift control on the radio so that the tuning indicator on the MFJ TNC is centered in its display area.

7. Adjust the audio output of your radio to TNC so that the DCD LED is flickering with false DCD indications. Make the adjustment so that the DCD duty cycle is more than 10 but less than 50 percent.

8. Carefully adjust the IF shift control on the radio to produce maximum DCD activity. This is the optimum point for the filter center frequency. Note the position of the IF shift control for future reference. This is the position you will want to use for all of the narrowband FSK modes.

If your radio has no provision for IF shift, you will have to determine the center frequency of the audio which is passed through the filter and realign the modem to the center frequency of the filtered audio. If you are lucky, this may turn out not to be necessary. The tuning indicator and DCD LED can be used to give you an indication when the modem is aligned with the filter similar to the indications described above. If the tuning indicator hovers around the center of the display when the modem is listening to noise being passed through the narrow filter as described above, realignment of the modem is unnecessary.

If you have determined that it is necessary to realign the modem center frequency to the radio filter center frequency, You should refer to **Appendix D** at the end of this instruction manual for the alignment procedure.

HF Packet Operation

Much has been said and written about the relative merits of HF versus VHF packet operation. HF packet operation is made to appear more difficult than VHF NBFM packet operation by several factors. Some of these are:

1. HF propagation is much more time variable and is more prone to produce intersymbol errors than is VHF propagation.

2. On the "published HF packet frequencies" many more stations are trying to use a single channel simultaneously than is the usual case on VHF.

3. Due to the wide area propagation characteristic of HF radio waves (sometimes nonreciprocal) with relatively dead "skipped" zones , the carrier sense multiple access (CSMA) feature of packet radio is a less than perfect arbitrator for time sharing the channel between users.

4. Many of the commercially available Terminal Node Controllers (TNC) for use on HF packet have data carrier detect (DCD) circuits which are of limited use or no use at all on a HF packet channel. This further degrades the effectiveness of CSMA.

The DCD circuit in the MFJ TNC has been optimized for the HF packet mode. It can be adjusted to ignore background noise while still being able to promptly respond to a valid data carrier. It has a "hang time" feature that prevents DCD dropouts when short multipath hits occur or collisions put phase discontinuities in the received data carrier. Thus, most multipath conditions will not cause the MFJ TNC to begin transmitting before the other station is in a listening mode. The DCD hang time also prevents the MFJ TNC from "piling on" a collision between 2 other stations on the channel. The DCD circuit in the MFJ TNC is NOT affected by the fact that there is a large amplitude difference between different signals on the same channel. So it will not allow you to collide with a relatively weak station which is transmitting immediately after a relatively strong station has finished.

5. Many of the stations on HF packet have no tuning indicator at all and many others have an indicator that is only marginally useful. Unlike VHF FM operation, frequency error between transmitter and receiver cause frequency errors in the modem tones. This is the reason that a good tuning indicator is absolutely essential for HF packet operation. The tuning indicator makes it possible for the operator to reduce the modem to modem frequency error to near zero. Reliable HF packet operation requires tuning errors of +\- 30 Hz or less.

6. Many of the stations currently operating HF packet do not have their radio bandwidth matched to the characteristics of a 300 baud 200 Hz shift FSK signal. This causes a severe degradation in modem performance resulting in unnecessarily increased numbers of retries and drastic reduction in data throughput for the SHARED channel.

Serious HF packet operation should not be considered without a 500 Hz filter in the receiver IF. An audio filter is NOT an acceptable substitute.

"Squeezing" the edges of SSB filters together with so called variable bandwidth tuning (VBT or PBT) to produce a 500 Hz bandpass is difficult to properly align and results in operation near the edges of the filters where the phase response and group delay characteristics are particularly poor. So while this offers some marginal improvement over wide filters, it is not a good substitute for a real 500 Hz filter.

In spite of the above factors, HF packet communications can be a reliable and enjoyable mode. The trick is to operate in a manner that allows you to avoid the problems mentioned above. Your purchase of an MFJ TNC has already helped you avoid the DCD and tuning indicator difficulties. Configuring your radio bandwidth to match the spectral characteristics of the HF packet FSK signal will allow you to avoid the modem performance degradation that results from excessive radio bandwidth. However, you will still be affected by other station's problems in these areas when operating on a crowded packet channel.

If you do have your radio configured for the proper bandwidth, you will notice that many stations you connect to will seem to not be able to copy you as well as you copy them. Don't worry, your transmitter output isn't low, you are just observing the difference between a good demodulator behind the correct radio bandwidth and any kind of demodulator behind a radio which has far too much bandwidth for the mode.

The actual mechanics of operating the MFJ TNC in the HF packet mode are the same as for the VHF packet mode. The main differences that will be apparent to you will be the slower baud rates, the higher incidence of propagation related effects and QRM, and the requirement for accurate tuning. It will take some practice before you can rapidly acquire another station's signal and initiate a contact.

Set the audio input to the TNC so that the DCD LED on the TNC just flickers occasionally. Set it so that the DCD duty cycle is between 10 and 20 percent.

DO NOT set the audio level so that the DCD LED never comes on even when receiving a signal!

Tuning in a signal is relatively easy to do once you get the hang of it. You must wait until the other station is sending a packet, and then tune the transceiver so that the tuning indicator LED is centered. If the DCD LED is not lit, the tuning indicator information is NOT valid.

Each bar on the tuning indicator represents about 10 Hz. Thus, if a packet comes through and you are 4 bars off, re- tune your transceiver 40 Hz in the indicated direction. The direction depends on the sideband you selected and the manner in which you have the tuning indicator oriented. One or two tries will quickly tell you which way to go! Bars to the left of center indicate you should tune higher, while the other side of center means to tune lower.

Once you have the other station tuned in, you may initiate a connect request just as you would on VHF.

Many BBS stations forward traffic on HF at the above frequencies. Call CQ a couple KHz away from such channels. If you can't raise anyone, call CQ on one of the above frequencies, **but QSY immediately after establishing contact!** Be careful on 20 meters especially that you don't operate +/- 2KHz around 14.100 MHz (you will cause interference to propagation beacons and give packet a bad name...)

Calling CQ on HF is a bit different than on VHF. One technique which has proven effective when NOT operating on one of the congested calling frequencies is to do the following:

1. Find a clear frequency and monitor it for long enough to make sure it really is clear.

2. Set "UNProto" to CQ if it isn't already. This is the default field for this parameter.

3. Command the MFJ TNC into converse mode by typing either:

K<CR>

or

CONV <CR>

4. Rapidly type a string of 15 to 20 carriage returns <CR>. This will cause the MFJ TNC to send a continuous string of unconnected information (UI) frames. Since this will be a relatively long burst of packet transmission, the potential receiving station will have plenty of time to tune your signal in. To a receiving station this will appear on his screen as:

YOURCALL > CQ:

YOURCALL > CQ:

YOURCALL > CQ:

YOURCALL > CQ:

YOURCALL > CQ:

One for each carriage return you typed.

Even a station which has no tuning indicator can eventually get you tuned in using this type of signal as he can tune around and watch his screen to see where printing is effective.

If you are meeting a friend on a schedule, you just set the "UNProto" field to "HISCALL" and do the same thing. When your friend finds you, this will appear on his screen as:

YOURCALL > HISCALL:

YOURCALL > HISCALL:

YOURCALL > HISCALL:

For as many <CR>s as you typed. Your friend will have little trouble finding you and tuning you in for the QSO.

5. After the MFJ TNC finishes sending the string of CQ packets, listen for 5 to 10 seconds to allow a station to attempt to connect with you. If you don't get any nibbles, send another string of CQ packets.

The above method of calling CQ is NOT appropriate for use on one of the crowded calling frequencies. There, everyone is already tuned more or less to the same frequency. To call CQ on one of the calling frequencies do the following:

1. Find the "center" of the channel by tuning the radio so that the tuning indicator is centered on most of the signals.

2. Make sure your "UNProto" field is set to CQ.

3. Enter converse mode.

4. Occasionally strike a <CR> (2 a minute or so if DCD lets your packets clear the channel that fast) and wait for the MFJ TNC to get an opportunity to squeeze the packet into the activity on the channel. Allow some time after your packet has been sent for someone to attempt a connect with you and then send another CQ packet by typing a <CR>.

5. If (when) someone connects, immediately negotiate a QSY to a clear channel. Then call him on the new frequency as outlined above (in the clear channel CQ procedure) for a scheduled contact.

Please use care in selecting the QSO frequency so as to avoid unnecessary interference to other amateur services. As in all amateur communication modes, it is polite to listen before you transmit!

Monitoring a propagation beacon frequency will not necessarily be sufficient to reveal this activity to you. It is best to make a note of which INDICATED frequencies you should avoid so that your radiated packet spectrum (from F(emission) above) will not get within several hundred Hz of a propagation beacon.

HF packet operation is fundamentally different than other modes of operation in 1 major respect. If you are on a clear channel, talking to only 1 other station, there will be long periods of silence. People using other modes and tuning around looking for a clear frequency to use may be fooled by the silence. Don't assume that an interfering station who shows up considerably after you have begun using the frequency is interfering on purpose, he may honestly not have been aware of your QSO in progress. For this reason, it is a good idea to keep the flow of the conversation going so that the lapses aren't too long. It can also

be advantageous to have more than one packet QSO on the channel but if more than a very few get on the same channel, the throughput falls off very fast as the likelihood that all stations are properly configured and have working DCD circuits is small.

Here are a few simple suggestions for operating HF packet which should help to get you started.

1. Do NOT try to hold a QSO on one of the calling frequencies. Use the calling frequency only to establish contact and then MOVE OFF TO A CLEAR FREQUENCY to carry on the QSO. Remember to be aware of the frequencies your station is actually transmitting so you can avoid interference to other services such as propagation beacons etc.

2. Configure your station so that you can hear the activity on the channel. This will allow you to easily avoid interfering with other stations and also to quickly diagnose the problem when throughput suddenly falls off for some reason (usually propagation or interference).

3. If possible, use the highest frequency band possible to communicate with any specific station. The closer you are to the maximum usable frequency (MUF) the less intersymbol interference you will have from multipath effects. If you have a schedule with another station, arrange your times and frequencies accordingly.

4. Set the following parameters off unless you have some specific reason for doing otherwise:

DIGIPEAT OFF (there is NO logical reason to enable this function in the HF mode)

DWAIT 0 (off)

AX25V2 (off)

CHECK 0 (off)

CMSG (off)

RETRY 0 (try forever , but NOT if unattended operation. This allows YOU to be the one to decide when or whether to give up rather than the MFJ

TNC. Typically you know more than the MFJ TNC does about whether the other station is still trying or is likely to recover from the latest fade.)

MAXFRAME 1 (multiple frames off) RESPTIME 0(some stations may have trouble copying your ACKnowledgments (ACKs) when you respond this fast. This is due to the fact that some radios pump up the AGC voltage during transmit and if the AGC time constant is long, they are essentially deaf for a while after transmitting. You will want to experiment with this value. In general, you will want to use the minimum usable amount.)

5. Set **FRACK** to at least 8. A value of 10 or 12 may be better on a very busy channel.

6. Restrict your use of beacon transmissions as much as possible. If you MUST use a beacon, keep it short and keep the repetition rate as low as possible. More than once a minute is definitely too frequent. once or twice in 10 minutes is more polite. Do not allow your beacons to continue if you are not in attendance. Nobody wants to connect to you just to be ignored.

7. If your radio allows you to select the AGC time constant (fast or slow AGC), set it to the fastest setting available to you.

If you cannot select fast AGC, it may be advantageous under some circumstances to partially defeat the AGC function by reducing RF gain and increasing AF gain. The demodulator in the MFJ TNC is extremely insensitive to absolute audio level. It will function properly with input levels from the low hundreds of millivolts up to many tens of volts. Thus, the variation in audio level produced by partially defeating the AGC system will not degrade the modem's ability to copy. The limiting factor on the high end is usually the ability of the receiver output stage to produce the voltage without clipping. The limiting factor on the low end is the hundred millivolts or so required to exceed the MFJ TNC's digital system noise seen at the demodulator input.

MFJ TNC KISS MODE AND HOST MODE

One unique feature offered by the MFJ TNC is that it can be switched into KISS mode to run programs such as TCP/IP.

Host Mode installed in the MFJ TNC requires a special terminal program to operate. Documentation for Host Mode is available on disk from MFJ upon request.

KISS Interface for TCP/IP

The **KISS** interface is installed in firmware of the MFJ TNC. Additional modification or replacement of firmware is not necessary.

KISS enables the MFJ TNC to act as a modem for a host computer. Turning KISS on allows the MFJ TNC to run programs such as TCP/IP, MSYS and other programs which use the Serial Link Interface Protocal (SLIP).

Before enabling KISS, make sure radio baud rate and terminal baud rate are set to the desired values. The terminal baud rate that's determined at sign on is the same that will be used for KISS.

Once the operating parameters have been selected, set KISS ON and then issue a RESTART command. The CON and STA LEDs will blink on and off three times to indicate that the MFJ TNC has entered the KISS mode. Now you may call up a TCP/IP, or another host program that can use KISS or "SLIP".

If you are using the TCP/IP program and wish to switch to the AX.25 mode of operation, you can issue the command: **param ax0 255**, then press "RETURN". This command must be issued under TCP/IP "net>" prompt and in lower case letters.

Once the MFJ TNC receives the "param ax0 255" command, it turns KISS off and will revert back to ordinary AX.25 mode of operation. When the MFJ TNC is powered on again, it will sign on to the AX.25 operation mode.

For details of operation the TCP/IP user should consult documentation provided with the TCP/IP program.

OPERATION COMMANDS

This chapter serves as a complete reference to all MFJ TNC commands. Commands are used to control the many variable values,which affect the MFJ TNC's operation, as well as causing it to perform specific functions, such as connecting to another station to start a QSO. You can enter a command to the MFJ TNC whenever you see the command-mode prompt:

cmd:

You will change parameters and issue instructions to the MFJ TNC by typing commands composed of English-like words or word abbreviations, which are called keywords, and variables which are numbers or strings of characters chosen by the user. You will probably never change some of these parameters; however, one of MFJ's goals is to allow each user maximum flexibility to adapt the MFJ TNC to his environment.

Entering Commands

You may use either upper case (capital letters) or lower case (small letters) when you enter commands. In order to have the MFJ TNC accept a command, you must finish command entry with a <CR>, or carriage return character. This won't be mentioned explicitly in the examples below. Before you type the final <CR> of your command, you can correct typing mistakes or cancel the line completely. If any command is misspelled to the point where the MFJ TNC does not understand it, then an error message will occur. See Chapter 4 for a discussion of input line editing.

This chapter will use UPPER CASE for commands and lower case for explanatory text. In examples showing input typed by the user together with the responses of the MFJ TNC, the user's input will be shown in bold face.

Whenever the MFJ TNC accepts a command which changes a value, it will display the previous value. For example, if you type

XFLOW OFF

you might see the display

XFLOW was ON

This reminds you of what you have done, and indicates that the value has been successfully changed.

If you type something the MFJ TNC can't understand you will get an error message. If you type an unrecognized command, you will see the message ?EH. If you get a command name correct, but the arguments are wrong, you will see the message ?BAD. A complete list of error messages appears at the end of this chapter. For example,

cmd:**ASDFASDF** This isn't a command.
?EH
cmd:**BEACON E** A parameter was left out.
?BAD

Command List

The commands are listed alphabetically, and each command entry contains several sections, as follows.

COMMAND NAME

The boldface command name at the top of the entry is the word you will type in order to have the MFJ TNC execute this command. The command name is printed with some letters underlined. These letters form the minimum abbreviation that you may use and still have the MFJ TNC understand your command. Of course, you may type out the entire command word, or any abbreviation longer than the minimum abbreviation, if you like. The command will still be accepted.

For example, the command **MY**CALL may be specified by simply typing MY. The abbreviation M is not sufficient (and will be interpreted as a different command), but MY, MYC, MYCA, MYCAL or MYCALL are all acceptable.

If the command requires parameters, they will be indicated after the command name.

Default

For commands that set values, the MFJ TNC assumes a "most often used" or default condition. The defaults are the values stored in EPROM which are loaded into RAM when the system is first powered up, or when you give the RESET command. Immediate commands perform particular functions rather than setting values, and don't have defaults.

Parameters

There are several types of parameters. Some parameters can have one of only two values, such as ON and OFF or EVERY and AFTER. If a parameter must be one of two values, the choices are shown separated by a vertical bar. You

may use YES instead of ON and NO instead of OFF.

A parameter designated as n is a numeric value. These values may be entered as ordinary decimal numbers, or as hexadecimal, or "hex", numbers by preceding the number with the $ symbol. When the MFJ TNC shows some of these numeric parameters (those which set special characters), they will be given in hex. The "digits" of a hex number represent powers of 16, analogous to the powers of 10 represented by a decimal number. The numbers 10 through 15 are denoted by the hex digits A through F. For example,

$1B = 1*16 + 11 = 27
$120 = 1*16*16 + 2*16 + 0 = 288

A parameter designated as text, such as the argument to CTEXT, may be entered in upper or lower case, and may include numbers, spaces, and punctuation. The text is accepted exactly as typed by the user.

Several commands require callsigns as parameters. While these parameters are normally Amateur call signs, they may actually be any collection of numbers and at least one letter,up to six characters; they are used to identify stations sending and receiving packets. A callsign may additionally include sub-station ID (SSID), which is a decimal number from 0 to 15 used to distinguish two or more stations on the air with the same Amateur call (such as a base station and a repeater). The call sign and SSID are entered and displayed as call-n, e.g., K0PFX-3. If the SSID is not entered, it is set to 0, and SSIDs of 0 are not displayed by the MFJ TNC.

Some commands have parameters which are actually lists of items. For example, you may specify as many as eight callsigns to be selectively monitored with the

command LCALLS. The second and later items in the list are optional, and you may separate the list items with blank spaces or with commas.

These examples may help you to understand the explanations above.

BEACON EVERY|AFTER n

means that the command BEACON requires an argument which must be either EVERY or AFTER (abbreviated to E or A), and an argument n which the user may choose from a range of values. An acceptable command might be BEACON E 2.

CONNECT call1 [VIA call2[,call3...,call9]]

means that the command CONNECT requires a callsign argument call1. You may optionally include the keyword VIA, followed by a list of one to eight callsigns, call2 through call9. The callsigns in the list, if included, must be separated by commas (as shown), or by blank spaces. An acceptable command might be C N2WX V AD7I WB9FLW.

You can see the current value of the command's arguments by typing the command name by itself, without any arguments. For example,

cmd:**CONOK Y**	Sets the value to YES (ON).
CONOK was OFF	Displays previous value.
cmd:**CONOK**	Command with no arguments
CONOK ON	displays present value.

A special command, DISPLAY, allows you to see the values of all parameters or groups of related parameters.

Remarks

This section describes the command's action and the meaning of each argument. Examples may be included of situations in which the command might be used.

8BITCONV ON|OFF Mode: Packet Default: ON

Parameters:

ON The high-order bit is not stripped in Converse Mode.

OFF The high-order bit is stripped in Converse Mode.

This command enables transmission of 8-bit data in Converse Mode. If **8BITCONV** is **OFF**, the high-order bit (bit 7) of characters received from the terminal is removed before the characters are transmitted in a packet. The standard ASCII character set requires only 7 bits, and the final bit is used as a parity bit or ignored. Setting bit 7 in text characters transmitted over the air may cause confusion at the other end.

If you need to transmit 8-bit data, but don't want all the features of Transparent Mode, you should set **8BITCONV ON** and **AWLEN 8**. This may be desirable, for example, if you are using a special non-ASCII character set.

Bit 7 is always removed in Command Mode, since commands require only the standard 7-bit ASCII character set.

ABOrt Mode: Mailbox Immediate Command

This command gives the **SYSOP** total control over the Mailbox by allowing him to force a disconnect on the Mailbox link. It immediately terminates any mailbox activity currently in progress. You may use it to avoid any QRM, to cancel a **FORWARD** or **NODEFORW** in progress. You can also use it to terminate mailbox usage by an unwelcome mailbox users.

ACKPRIOR ON|OFF Mode: Packet Default: ON

ACKPRIORITY permits an acknowledging TNC to transmit without regard to the slotting delay. Turning **ACKPRIOR**iyty ON to enable prioritized acknowledgement.

If ACKprior is turned off and SLots (see SLots) is set to 0, the modified AX.25 protocol is effectively disabled. The MFJ TNC will behave like normal AX.25 protocol.

Prioritized acknowledgments and slotted channel access can be enabled or disabled independently of one another. So you could if you wished run normal AX.25 with slotted channel access or the new protocol without slotted channel access.

ACKTIME nnnn Mode: Packet Default: 14 (140 ms)

Parameters:

nnnn 0 - 250, in 10 ms intervals.

The **ACKTIME** parameter controls a delay that occurs whenever any packets have been received by the MFJ TNC that are not addressed to the MFJ TNC.

ACKTIME should be calculated by the radio channel baud rate, and by the keyup and keydown (TXDELAY and fixed timer, in TNC) delays. It should reflect the time it takes for an acknowledging TNC on the channel to keyup, send it's acknowledgement, and release the PTT. This represents the time required to send a response frame (with no I field appended) at the baud rate being used on the radio port.

The current 100 millisecond default is close but should be adjusted for 1200 baud work to 130 milliseconds (ACKTime set to 13).

For 300 baud HF work this parameter should be set to 520 milliseconds (ACKTime set to 52).

ANSWRQRA ON|OFF Mode: Packet Default: ON

Parameter:

ON MFJ TNC responds to non-digipeated UI frames addressed to QRA, within 1 to 16 seconds, with an empty ID packet.

OFF Disables MFJ TNC 's ping-response function.

QRA ("Who are you") pinging is supported by the MFJ TNC. A QRA ping polls all of the TNCs within range. A random number of seconds later, each TNC that

heard the QRA ping will transmit its identification packet. The purpose of this feature is to reveal to the packeteer, particularly the transient one, the names of all reachable TNCs and digipeaters.

Sending a QRA ping:

1) Set the unprotocol callsign to QRA

cmd: UNPROTO QRA<cr>

2) Manually send an unconnected packet

cmd: CONVERSE<cr>
<cr>
^C
cmd:

This sequence will send an unconnected packet. Once the local TNCs have responded with ID packets, then the user can press a "CRTL-C". The MFJ TNC will respond with the cmd: prompt.

AUTOLF ON|OFF Mode: Packet Default: ON

Parameters:

ON A linefeed character (<LF>) is sent to the terminal after each carriage return character (<CR>).

OFF A <LF> is not sent to the terminal after each <CR>.

AUTOLF controls the display of carriage return characters received in packets as well as echoing those that are typed in.

If the MFJ TNC's sign-on message lines appear to be typed over each other, you should set **AUTOLF ON**. If the MFJ TNC sign-on message appears to be double-spaced, you should set **AUTOLF OFF**. If the MFJ TNC's sign-on message appears to be single-spaced, you have **AUTOLF** set correctly.

This command only affects what is displayed, not the data sent in packets. If you want to add linefeed characters to outgoing packets, use the command **LFADD**.

AWLEN n Mode: All Default: 8

Parameters:

n 7 - 8, specifying the number of data bits per word.

This value defines the word length used by the serial IO terminal port.

For most packet operations, including conversation, bulletin board operation, and transmission of ASCII files, you should set **AWLEN 7**. If 8 bit words are transmitted to the MFJ TNC in Command Mode or Converse Mode, the eighth bit is normally removed, leaving a standard ASCII character, regardless of the setting of **AWLEN**.

To transmit and receive packets retaining all 8 data bits of each character, as you need to do if you send executable files or other special data, you should use Transparent Mode and set **AWLEN 8**. Alternatively, you can use Converse Mode and set **AWLEN 8** and **8BITCONV ON** (however, the data you then send must handle the Converse Mode special characters with the PASS prefix).

If the AWLEN command is changed, then the user must perform a RESTART on the MFJ TNC. If not, the command will remain unchanged.

AX25L2V2 ON|OFF Mode: Packet Default: ON

Parameters:

ON The MFJ TNC will use AX.25 Level 2 Version 2.0 protocol.

OFF The MFJ TNC will use AX.25 Level 2 Version 1.0 protocol.

Some implementations of the earlier version of AX.25 protocol (e.g., TAPR's TNC 1) won't properly digipeat version 2.0 AX.25 packets. This command exists to provide compatibility with these other TNCs until their software has been updated.

During the protocol transition period, you should set **AX25L2V2 OFF**.
After your local area TNCs are updated to the newer protocol version, you should set **AX25L2V2 ON**.

When **AX25L2V2** is **ON**, the MFJ TNC answers L2 UI frames with P and C set with either: RR if connected (regardless of rcvr flow control state), or DM if not connected.

If retry limit is exceeded, or the MFJ TNC receives a "disconnected" response to a poll, the connection is ended.

AXDELAY n Mode: Packet Default: 0

Parameters:

n 0 - 180, Specifying the voice repeater keyup delay in 10 ms intervals.

AXDELAY specifies a period of time the MFJ TNC is to wait, in addition to the normal delay set by **TXDELAY**, after keying the transmitter and before data is sent. This feature will be used by groups using a standard "voice" repeater to extend the range of the local area network. Repeaters with slow mechanical relays, split sites, or other circuits which delay transmission for some time after the RF carrier is present require some amount of time to get RF on the air.

If you are using a repeater that hasn't been used for packet operations before, you will have to experiment to find the best value for n. If other packet stations have been using the repeater, check with them for the proper setting. Note that this command acts in conjunction with **AXHANG**.

Note that the TAPR TNC 1 and other TNCs using the same version 3.x firmware interpret n in 120 ms intervals. The value set by **AXDELAY** on MFJ TNC will thus be 12 times the value used by a TNC 1 user to give the same delay time.

AXHANG n Mode: Packet Default: 0

Parameters:

n 0 - 20, Specifying the voice repeater hang time in 100 ms intervals.

This value can be used to increase channel efficiency when an audio repeater with a hang time greater than 100 ms is used. For a repeater with a long hang time, it is not necessary to wait for the repeater keyup delay after keying the

transmitter if the repeater is still transmitting. If the TNC has heard a packet sent within the hang period, it will not add the repeater keyup delay (**AXDELAY**) to the keyup time.

If you are using a repeater that hasn't been used for packet operations before, you will have to experiment to find the best value for n. If other packet stations have been using the repeater, check with them for the proper setting.

Note that the TAPR TNC 1 and other TNCs using the same version 3.x firmware interpret n in 120 ms intervals. The value you set on MFJ TNC for **AXHANG** will thus be 6/5 the value used by a TNC 1 user for the same hang time (when converting, round down to the nearest integer).

BBSMSGS ON|OFF Mode: Packet Default: OFF

This command controls how the MFJ TNC displays certain messages in command and CONVERSE modes. The messages affected are described below:

MESSAGE	EFFECT WHEN BBSMSGS ON
***CONNECTED to xxxx	A newline is added just before"***"
***DISCONNECTED	" "
***retry limit exceeded	" "
***xxxx Busy	" "
***FRMR sent	" "
***FRMR rcvd	" "
***Connect request:xxxx	This message is omitted.

The **BBS**MSGS command is primarily useful for host operation. Primarily with WORLI and like bulletin board systems that require link status messages to begin in the first output column.

The connect request message is omitted during BBSMSGS mode. This should be most useful for preventing corruption of messages when forwarding with small frames.

BEACON E|A n Mode: Packet Default: EVERY 0

Parameters:

EVERY	Send beacon at regular intervals.
AFTER	Send beacon once after the specified time interval with no packet activity.
n	0 - 250, specifying beacon timing in 10 second intervals. A value of 0 disables the beacon.

This command enables beacon sending and causes the first beacon frame to be transmitted. A beacon frame consists of the text specified by **BTEXT** in a packet addressed to "BEACON" and sent via the digipeat addresses specified by the **UNPROTO** command, if any.

If the keyword **EVERY** is specified, a beacon packet is sent every n*10 seconds. This mode might be used to transmit packets for testing purposes.

If **AFTER** is specified, a beacon is sent only after n*10 seconds have passed with no packet activity. In this case, the beacon is sent only once until further activity is detected. This mode can be used to send announcements or test messages only when packet stations are on the air. If you choose n properly you can avoid cluttering a busy channel with unnecessary transmissions.

Beacon frames from other TNCs can be monitored by setting **MONITOR ON**.

NOTE: BEACONS will not be sent if **BTEXT** is null.

BKONDEL ON|OFF Mode: Packet Default: ON

Parameters:

ON The sequence <BACKSPACE> <SPACE> <BACKSPACE> is echoed when a character is deleted from the input line.

OFF The <BACKSLASH> character (\) is echoed when a character is deleted.

This command determines the way the display is updated to reflect a character deletion in Command Mode or Converse Mode.

The <BACKSPACE> <SPACE> <BACKSPACE> sequence will properly update the screen of a video display. If you have a video display terminal or **computer,** you should set **BKONDEL ON**.

The <BACKSPACE> <SPACE> <BACKSPACE> sequence on a printing terminal would result in overtyped text. If you have a paper-output display, or if your terminal does not respond to the <BACKSPACE> character (<CTRL-H>), you should set **BKONDEL OFF**. The MFJ TNC will type a <BACKSLASH> for each character you delete. You can display the corrected input line by typing the redisplay-line character, which is set by the command **REDISPLA**.

BLP ON|OFF Mode: Packet Default: OFF

Parameters:

ON Puts MFJ TNC into Host Mode

OFF Takes MFJ TNC out of Host Mode

When the **BLP** command is turned ON, the MFJ TNC is put into Host Mode. After you turn BLP ON and enter transparent mode the host code will run. Once BLP is on, subsequent RESTARTS and power up cycles will be directly and silently into transparent mode and it will continue to do so until you turn **BLP** back **OFF** or the bbRAM fails.
In order to run the Host Mode code the following commands must be set up as stated:
CONMODE TRANS|CONV

You MUST set CONMODE to TRANS else the first time you're connected you'll lose the DLC connection! This is actually putting the MFJ TNC into Transparent mode.

PARITY 0

The Parity must be set to 0 for Host Mode operations.

AWLEN

Set the AWLEN command for 8 bits!

MON ON|OFF

If you have BLP ON and MON ON, >ALL< packets-data, command, beacons, whatever - will be sent to the host on BLP channel 0x71. If you're being inundated with countless frames when debugging you might want to turn monitor off to avoid the mess.

MYDLCNUM

DEFLTDLC

Effective only when non-0 MYDLCNUM, this parm tells the TNC what the DLC address is of the host (ex, MTHOST). Default is 254.

BTEXT text Mode: Packet Default: ""

Parameters:

text Any combination of characters, numbersand paces, up to a maximum length of 128 characters.

BTEXT specifies the content of the data portion of a beacon packet. The default text is an empty string, i.e., no message. Beacon packets are discussed in more detail under the **BEACON** command.

NOTE: BEACONS will not be sent if BTEXT is null.

You can send multiple-line messages in your beacon by including carriage return (<CR>) characters in the text. The <CR> character can be included by preceding it with the pass character. The pass character is set by the **PASS** command. If you enter a text string longer than 120 characters, an error message will appear and the command will be ignored.

For example, a Bulletin Board program might set the beacon **text** to a message like this, updating the **text** after each connection:

Mailbox on line. Messages for WB9FLW, AD7I, K9NG.

To clear the **BTEXT text** without issuing the **RESET** command, use a % or & character as the first character in the text.

BUDLIST ON|OFF Mode: Packet Default: OFF

Parameters:

ON Ignore frames from stations which are not in the **LCALLS** list.

OFF Ignore frame from stations which are in the **LCALLS** list.

BUDLIST works in conjunction with the command **LCALLS**, which sets up a **callsign** list. These commands determine which packets will be displayed when you have set **MONITOR ON**. **BUDLIST** specifies whether the **callsigns** in the list are the ones you want to ignore or, alternatively, are the only ones you want to listen to.

If you want to listen only for packets from a limited list, you should enter this list with **LCALLS** and set **BUDLIST ON**. You can use this feature, for example, to have your TNC "keep an ear out" for a particular station while you converse with someone else.

If you want to ignore packets from a limited list, you should list the **callsigns** to ignore in **LCALLS** and set **BUDLIST OFF**. For example, if there is a bulletin board on frequency, you can ignore it while monitoring other conversations.

CALIBRA Mode: All

CALIBRA is an immediate command, and is used to transfer control to the modem calibration routine. Calibration may be performed at any time without altering the current link state.

Briefly, the commands available in the calibration routine are:

<SPACE>	Switches between the Mark and Space transmit audio tones.
D	Alternates between the two transmit tones at a rate determined by the radio baud rate. This will help you to calibrate the demodulator.
K	Activates the modulator and Toggles the PTT line on/off.
Q	Quits the calibration routine, and returns to command mode.

CALSET n Mode: All Default: None

Parameters:

n	0 - 65535,	Specifying the count setting for use by the calibration routine.

The number to be specified by **CALSET** is determined by the frequency f to be calibrated as follows.

n = (525,000 / **f**) + 1 (modulator tones)
n = (262,500 / **f**) + 1 (demodulator tones)

In calibrating the modulator tones, the frequency **f** will be the actual modulator tone desired. When calibrating the demodulators, frequency **f** is the average frequency between the Mark and Space frequencies.

Round **n** to the nearest integer. To calibrate the modem tones, you will set n for the desired frequency using **CALSET**.

CANLINE n Mode: Packet Default: $18 <CTRL-X>

Parameters:

n 0 - $7F, specifying an ASCII character string code.

This command is used to change the cancel-line input editing command character. The parameter n is the ASCII code for the character you want to type in order to cancel an input line. You can enter the code in either hex or decimal.

For example, to change the cancel-line character to <CTRL- U>, you would set **CANLINE $15** or **CANLINE 21**.

If you cancel an input line in Command Mode, the line will be terminated with a <BACKSLASH> character, and you will see a new **cmd**: prompt on the next line. If you cancel a line in Converse Mode, you will see only the <BACKSLASH> and a new line. You can cancel only the line you are currently typing. Once a <CR> has been entered, you can not cancel an input line using the cancel-line character. Note that if your send-packet character is not <CR>, the cancel-line character will cancel only the last line of a multi-line packet. To cancel the entire packet, use the **CANPAC** character.

Line cancellation, like all other input editing features, is disabled in Transparent Mode.

CANPAC n Mode: Packet Default: $19 <CTRL-Y>

Parameters:

n 0 - $7F, specifying an ASCII character string code.

CANPAC is used to change the cancel-packet input editing command character. The parameter n is the ASCII code for the character you want to type in order to cancel an input packet. You can enter the code in either hex or decimal.

If you cancel a packet in Converse Mode, the line will be terminated with a <BACKSLASH> character and a new line. You can only cancel the packet that is currently being entered. Once you have typed the send-packet character, or waited **PACTIME** (if **CPACTIME** enabled), the packet can not be canceled even if it has not been transmitted.

Packet cancellation, like other input editing features, is disabled in Transparent Mode.

Cancel Display Output

The cancel-packet character also functions to cancel display output in Command Mode. If you are in Command Mode and type the cancel-packet character, any characters that would be typed on the screen (except echoed characters) are "thrown away" by the MFJ TNC. Typing the cancel-output character a second time restores normal output. To see how this works, try typing **DISPLAY**, then type a <CTRL-Y>. The command list display will stop. You won't see any response from the MFJ TNC to commands. Now type another <CTRL-Y>, and type **DISPLAY** again to see that the display is back to normal.

You can use the cancel-display feature if you inadvertently do something that causes the MFJ TNC to generate large amounts of output to the terminal, such as giving the **DISPLAY** command or setting **TRACE ON**. If you are in Converse Mode or Transparent Mode and want to cancel display output, you must exit to Command Mode and then type the cancel- packet character.

CBELL ON|OFF Mode: Packet Default: OFF

Parameters:

ON Connect bell enabled

OFF Connect bell disabled

This command is used to control whether an ASCII $O7 or CTRL-G (BELL) character is sent as part of the connected message.

When set ON, the bell character immediately preceeds the asterisk portion of the connected message, e.g.:

<BELL>* Connected to: <callsign>**

When **CBELL** is **ON** a tone will also be heard on the external speaker. A speaker must be connected to the SPEAKER jack in the rear panel of the MFJ TNC, in order to hear this tone.

CHAT Mode: Mailbox Default: command

The **SYSOP** may, at any time, break onto the mailbox's connected link. The resulting mode is like the a typical CONVERS mode packet connection. **CHAT** immediately terminates any user or forwarding operation in progress. At the point when the **SYSOP** invokes Chat mode, the **SYSOP** and the connectee are in an actual packet QSO. This is good to discuss problems with the Mailbox or equipment failure. **CHAT** mode continues until the **SYSOP** returns to command mode.

CHECK n Mode: Packet Default: 12

Parameters:

n 0 - 250, Specifying the check time in 10 second intervals. A value of 0 disables this feature.

This command sets a connection timeout. If a link connection exists between the MFJ TNC and another station, and the other station "disappears," your MFJ TNC could remain in the connected state indefinitely, refusing connections from other stations. This might happen if propagation changes unexpectedly or an intermediate digipeater station is turned off. In order to prevent this sort of lockup, the MFJ TNC will try to clean up the link if the specified time elapses without any packets being heard from the other TNC. The operation of this feature depends on the setting of **AX25L2V2**.

If **AX25L2V2** is **ON**, the MFJ TNC will send a "check packet" to verify the presence of the other station if no packets have been heard from it for n*10 seconds. This frame contains no information, but is interpreted by the receiving station's TNC as an inquiry as to whether it is still connected. If the receiving TNC is still connected, it sends an appropriate response packet. If the TNC initiating the inquiry does not hear a response after RETRY+1 attempts, it commences a disconnect sequence, as if the **DISCONNE** command had been given.

If **AX25L2V2** is **OFF** and the other station has not been heard for n*10 seconds, the MFJ TNC will not attempt an inquiry, but will send a disconnect packet, just as if you had typed the command **DISCONNE**.

CHECKV1 ON|OFF Mode: Packet Default: OFF

The CHECKV1 parameter enables the automatic idle-link- disconnect feature for AX.25 Level 2 Version 1 connections. The idle time before disconnecting will be equivalent to the AX.25 CHECK parameter (see CHECK command).

CONPERM ON|OFF Mode: Packet Default: OFF

Parameters:

ON The current connection on the current stream will not be allowed to enter the disconnected state.

OFF The current stream may be connected to and disconnected from other stations.

This command, when switched **ON**, forces the MFJ TNC to always maintain the current connection, even when frames to the other station exceed **RETRY** attempts to get an acknowledgment. **RESTART** and power off/on cycling will not affect this connected state.

This command only takes effect when a connection is established. It functions on a stream-by-stream basis when multiple connections are allowed.

It is useful for certain networking applications, meteor scatter and other noisy, less-reliable links, while still allowing connections on other streams to operate normally (automatic disconnect based on **RETRY**, etc.).

CMDTIME n Mode: Packet Default: 1

Parameters:

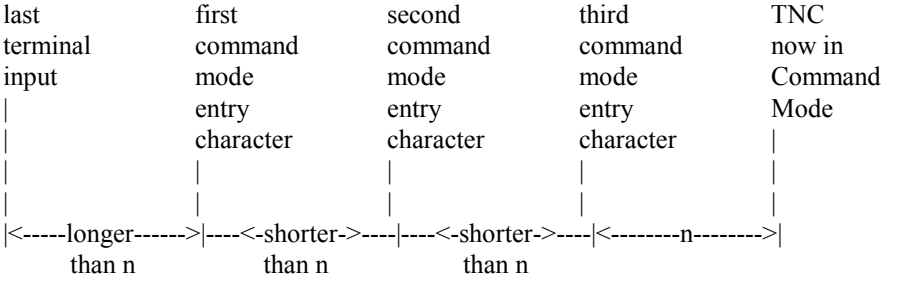
n 0 - 250, Specifying Transparent Mode timeout value in 1 second intervals. If n is zero, the only exit from Transparent Mode is to send a BREAK signal or interrupt power to the MFJ TNC.

This command sets the Transparent Mode timeout value. In order to allow escape to Command Mode from Transparent Mode while permitting any character to be sent as data, a guard time of n seconds is set up.

The same Command Mode entry character used for exit from Converse Mode is used to exit Transparent Mode, but the procedure is different. (The Command Mode entry character is set by **COMMAND**.) Three Command Mode entry characters must be entered less than n seconds apart, with no intervening characters, after a delay of n seconds since the last characters were typed. After a final delay of n seconds, the MFJ TNC will exit Transparent Mode and enter Command Mode. You should then see the prompt

cmd:

The diagram below illustrates this timing.



CMSG ON|OFF Mode: Packet Default: OFF

Parameters:

ON A text message is sent as the first packet after a connection is established.

OFF The text message is not sent.

CMSG enables automatic sending of the message set by **CTEXT** whenever your MFJ TNC accepts a connect request from another TNC.

For example, if you have left your station running even though you don't want to operate just now, you might want to set **CMSG ON** to let people know that you can't talk when they connect to your MFJ TNC. When you are ready to operate, you would set **CMSG OFF**.

CMSGDISC ON:OFF Mode: Packet Default: OFF

Parameters:

ON Automatic disconnect enabled

OFF Automatic disconnect disabled

This command controls whether the MFJ TNC will initiate a disconnect sequence after it is connected to.

If **CMSG** is **OFF**, or **CTEXT** has no connected text, the MFJ TNC initiates a disconnect immediately upon receiving information or acknowledgement frames from the other station.

If **CMSG** is **ON** end **CTEXT** contains some text information, the MFJ TNC initiates a disconnect after the packet containing connect text (**CTEXT**) is acknowledged.

This command may be useful to bulletin board operators or others with a need to send a short message, confirm its receipt, and disconnect.

NOTE: Use this command with care. If you find you're able to receive connects, yet never get data, it's possible **CMSG**Disc has been left on. It's also possible is that RS-232 DCD is holding the terminal off -- see Chapter 5 for details on hardware flow control.

COMMAND n Mode: All Default: $03 <CTRL-C>

Parameters:

n 0 - $7F, Specifying an ASCII character code.

This command is used to change the Command Mode entry character. You can enter the code in either hex or decimal.

Command Mode is entered from Converse Mode when this character is typed. If you type the Command Mode entry character while you are already in Command Mode, nothing will happen. To see how this works, enter Converse Mode by typing **CONVERS**. Anything you type will become packet data. Now type a <CTRL-C>. You will see the Command Mode prompt, indicating successful exit from CONVERSE mode to Command Mode. The display might look like this:

cmd:**CONVERS**
Hello World! I'm on the air on packet radio!
[enter <CTRL-C>]
cmd:

See the entry under **CMDTIME** or the discussion of Transparent Mode in Chapter 5 for information on how the Command Mode entry character is used for escape from Transparent Mode.

For terminals without a "control" key, you will have to reasign another key such as a graphic symbol or punctuation mark which is normally not used in operations.

CONMODE **C**ONVERS **T**RANS Mode: Packet Default: CONVERS

Parameters:

CONVERS	Sets automatic entry to Converse Mode when a connection is established.
TRANS	Sets automatic entry to Transparent Mode when a connection is established.

CONMODE controls which mode the MFJ TNC will be placed in after a connection is established. The connection may result either from a connect request received over the air or a connect initiated by a **CONNECT** command that you issued. For most operations, you would set **CONMODE** to **CONVERS**. However, if you are using Transparent Mode for a bulletin board program, for example, you would set **CONMODE** to **TRANS** so that the correct mode will be entered when your bulletin board receives a connect request.

If you initiate a connection with the **CONNECT** command, the control of Converse or Transparent Mode is determined by **NEWMODE**.

If the MFJ TNC is already in Converse or Transparent Mode when the connection is completed, the mode will not be changed. If you have typed part of a command line when the connection is completed, the mode change will not take place until you complete the command or cancel the line. This prevents the last part of your command from inadvertently being sent as a packet.

CONNECT call1 [V**I**A call2[,call3...,call9]] Mode: Packet

Parameters:

call1 Callsign of TNC to be connected to.

call2 Optional callsign of MFJ TNC to be digipeated through. As many as eight digipeat addresses can be specified.

The part of the command line in brackets, **VIA call2[, call3...,call9]** is optional. The double-bracketed text, ,**call3...,call9**, is also optional, but would only be used if **VIA call2** is present. The brackets are not typed.

Each **callsign** may include an optional sub-station ID specified as -n immediately following the **callsign.** The digipeat fields are specified in the order in which you want them to relay the packets to the destination, **call1**.

CONNECT is an immediate command. It initiates a connect request to MFJ TNC **call1**, optionally through digipeaters. If **NEWMODE** is **ON**, the MFJ TNC will immediately enter Converse Mode or Transparent Mode, as specified by the command CONMODE. If **NEWMODE** is **OFF**, the MFJ TNC will enter Converse Mode or Transparent Mode when the connection is successfully completed.

An error message is returned if the MFJ TNC is in a connected state, or is already attempting to connect or disconnect. If no response to the connect request occurs after the number of attempts specified by **RETRY**, the command is aborted and a message is typed. The MFJ TNC returns to Command Mode if

NEWMODE is **ON**. If **NEWMODE** is **OFF**, the mode does not change, i.e. the MFJ TNC remains in Command Mode.

For example, to connect to WA7GXD using N0ADI-1 (who is near your QTH) and WD0ETZ (who is near GXD's QTH) as digipeaters, you would type

CONNECT WA7GXD VIA N0ADI-1,WD0ETZ

Packets coming back from WA7GXD access the digipeaters in the opposite order. Thus, packets from WA7GXD will first be repeated by WD0ETZ, then by N0ADI-1.

CONOK ON|OFF Mode: Packet Default: ON

Parameters:

ON Connect requests from other TNCs will be accepted.

OFF Connect requests from other TNCs will be rejected.

This command determines the action taken by the MFJ TNC when a connect request for it is received though the radio. If **CONOK** is **ON**, the request will be acknowledged, the standard connect message will be typed and either Converse or Transparent Mode will be entered, depending on the setting of **CONMODE**.

If **CONOK** is **OFF** and the MFJ TNC is not in Transparent Mode, the TNC will notify you of the connect attempt with the following message.

connect request: <call>

The **callsign** of the station trying to connect will replace **<call>**.

All connect requests from stations with totally blank callsigns are rejected with a busy response.

The MFJ TNC will also issue a DM packet, or "busy signal" to the requesting station. The user may then issue his own connect command. If the MFJ TNC receives a DM packet in response to a connect request, it will type the message

*** <call> station busy

with the **callsign** of the station that sent the DM packet in place of **<call>**.

For example, if you want to leave your station running as a digipeater you might set **CONOK OFF** until you are ready for a conversation. If you get a connect request in the meantime, you can change your mind. Stations attempting to connect to your MFJ TNC will be able to see that the station is up but not available for connection (it might still be useful as a digipeater).

CONSTAMP ON|OFF Mode: Packet Default: OFF

Parameters:

ON Connect and disconnect status messages are time stamped.

OFF Connect status messages are not time stamped.

This command enables time stamping of ***** CONNECTED** status messages. The date and time information is then available for use by Bulletin Board programs or other computer applications. The date and time must be set initially by the **DAYTIME** command before time stamping will occur. The date format is determined by the **DAYUSA** command.

For example, if **CONSTAMP** is **ON**, **DAYUSA** is **ON**, and the date and time have been set, a connect message might appear as follows.

***** CONNECTED to N2WX [05/28/85 16:28:31]**

CONVERS Mode: All

CONVERS is an immediate command, and will cause the MFJ TNC to exit from Command Mode into Converse Mode. Any link connections are not affected. Once in Converse Mode, everything you type is packetized and transmitted over the radio. Typing the Command Mode entry character returns the MFJ TNC to Command Mode. See the discussions of Converse Mode in Chapter 4 and Chapter 5.

CPACTIME ON|OFF Mode: Packet Default: OFF

Parameters:

ON Packet timeout is used in Converse Mode.

OFF Packet timeout is not used in Converse Mode.

This command enables the periodic automatic sending of packets in Converse Mode. This feature may be used for computer communications, such as Bulletin Board operation, when the full Transparent Mode features are not desired.

If CPACTIME is ON, characters are packetized and transmitted periodically as they are in Transparent Mode, but local editing and display features of Converse Mode are enabled, and software flow control may be used. For a discussion of

how periodic packetizing works, see the command PACTIME, which controls the rate and mode of packet assembly.

You should set CR OFF in this mode, since otherwise the send-packet character will be inserted in the data being packetized even though it was not typed. In order to include <CR> characters in transmitted packets, set SENDPAC to a normally unused character (e.g., <CTRL-P>), at which point the TNC will treat <CR> as an ordinary character.

You can set CPACTIME ON for a mode of operation similar to full break-in CW, in which your text is transmitted soon after you type it, but in short bursts of a few characters, and the other station may break in at will. Some operators find it easier to carry on a conversation in this mode, since it eliminates the delays while long packets are being typed.

CR ON|OFF Mode: Packet Default: ON

Parameters:

ON The send-packet character, normally <CR>, is appended to all packets sent in Converse Mode.

OFF The send-packet character is not appended to packets.

When CR is ON, all packets sent in Converse Mode will include, as the last character of the packet, the send-packet character which forces the packet to be sent. If CR is OFF, the send-packet character is interpreted solely as a command to the MFJ TNC, not as data to be included in the packet, and furthermore, it will not be echoed to the terminal.

Setting CR ON and SENDPAC $0D results in a natural conversation mode. Each line is sent when a <CR> is entered, and arrives at its destination with a <CR> at the end of the line. If the station at the other end reports overprinting of lines on his display, you can set LFADD ON, or the other station can set AUTOLF ON.

CTEXT text Mode: Packet Default: ""

Parameters:

text Any combination of characters and spaces, up to a maximum length of 120 characters.

CTEXT specifies the text of the packet to be sent after a connection is made, if CMSG is ON. The default **text** is an empty string, i.e., no message.

You can send multiple-line messages by including carriage return (<CR>) characters in the text. The <CR> character can be included by using the pass character immediately preceding it (see the PASS command). If you enter a text string longer than 120 characters, an error message will appear and the command will be ignored.

For example, you might set your **CTEXT** message to

I'm not here right now, but you may leave a message.

To clear the **CTEXT text** without issuing a **RESET** command, use a % or & as the first character in the message.

You cannot connect to yourself and see your CTEXT unless going thru a digipeater. CMSG only takes effect if you are connected to by another TNC.

CSTATUS Mode: Packet

CSTATUS is an immediate command which shows the stream identifier and link state of all ten streams (links), the current input and output streams, and whether or not each stream is "permanent" (see **CONPERM**).

An example of a display resulting from issuing a **CSTATUS** command is:

```
cmd:CS
        A stream        IO Link state is: CONNECTED to 305MLB
        B streamLink state is: CONNECTED to AD7I P
        C streamLink state is: DISCONNECTED
        D stream        Link state is: CONNECTED to N0ADI
                        via K9NG-2

        I stream        Link state is: CONNECT in progress
        J stream        Link state is: CONNECTED to KV7B
                        via NK6K-1
```

The example above shows the A stream is assigned both the input and output streams. The B stream is connected to AD7I "permanently." All other streams' states are shown as they might normally appear with multiple connections.

DAYTIME date&time Mode: Packet No default

Parameters:

date&time Current date and time to set.

This command allows you to set the current date and time for the MFJ TNC. The format for entering the **date&time** is

yymmddhhmm

where **yy** is the last two digits of the year, **mm** is the two- digit month code (01-12), **dd** is date (01-31), **hh** is the hour (00-23), and **mm** is the minutes after the hour (00-59). All these codes must be exactly two digits, so that numbers from 0 to 9 must be entered with leading zeros. The MFJ TNC does not check thoroughly for the correct number of days in a month, so you should use some judgment when you set the date.

The **date&time** parameter is used by the commands **CONSTAMP** and **MSTAMP** to "time stamp" received and monitored messages. Entries in the "heard" (displayed by **MHEARD**) are also time stamped if **date&time** has been set. The MFJ TNC's time is updated continuously as long as it is powered up. You must reset the date and time each time you turn on the MFJ TNC. If you don't do this, the commands **CONSTAMP** and **MSTAMP** will not enable time stamping.

If you type **DAYTIME** without a parameter, the MFJ TNC will display the current date and time. The format of the display is **dd-mm-yy hh:mm** if **DAYUSA** is **OFF**, and **mm/dd/yy hh:mm** if **DAYUSA** is **ON**. The format for entering **date&time** is not affected. For example,

cmd:**DAYTIME 8402291530**

sets the date and time to February 29, 1984 at 3:30 PM. The display of the date and time, with DAYUSA ON would be:

cmd:**DAYTIME**
02/29/84 15:30:26

DAYUSA ON|OFF Mode: Packet Default: ON

Parameters:

ON Date is displayed in the format **mm/dd/yy**.

OFF Date is displayed in the format **dd-mm-yy**.

This command determines the format for the MFJ TNC's display of the date. If **DAYUSA** is **ON**, the standard U.S. format is used; if **DAYUSA** is **OFF**, the standard European format is used. This command affects the format of the date display used in "time stamps" as well as the display when **DAYTIME** is entered without parameters. The format for entering the time using **DAYTIME** is not affected.

For example, if **DAYUSA** is **ON**, then July 2, 1984 at 9:28:44 AM would be displayed as

cmd:**DAYTIME**
07/02/84 9:28:44

If **DAYUSA** is **OFF** the same date and time would appear as

cmd:**DAYTIME**
02-07-84 9:28:44

DEADTIME nnn Mode: Packet Default: 33 (330 ms)
Parameter:

nnn 0 thru 250 in 10ms

The **DEADTIME** parameter selects the basic time interval used by the slotting procedures. A delay of length = (random multiple of **DEADTIME**) will be applied to the all outgoing packets that are not acknowledgmented.

DEADTIME must be set to a value that accounts for the slowest acceptable station on the channel. It includes the time required for the remote station's radio

to come on the air properly after assertion of PTT (TXDelay) and the time required for the local station's squelch (if used) and TNC DCD circuits to allow generation of a "DCD true" signal in the local TNC. Ideally, once the proper value for this timer is ascertained, all stations on the channel will use the same value.

The current default for this parameter is a short 30 milliseconds. This represents only the worst case delay for the TNC's DCD circuit and completely ignores the radio delays.

Most HF linear mode radios are MUCH faster than VHF FM radio. A reasonable setting for HF work is 120 milliseconds (DEAdtime set to 12). This should work fine with virtually any HF radio stable enough to consider using on HF packet.

DELETE ON|OFF Mode: Packet Default: OFF

Parameters:

ON The delete character input editing character is <DELETE> ($7F).

OFF The delete character input editing character is <BACKSPACE> ($08).

This command is used to change the input editing command for character deletion. When this character is typed, the last character from the input line is deleted. How the TNC indicates the deletion is controlled by the **BKONDEL** command.

You can not use this character to delete past the beginning of a line, although you can delete <CR> characters that have been entered in the text with the pass character.

To see a corrected display of the current line after you have deleted characters, type the redisplay-line character, which is set by the **REDISPLA** command.

DEFLTDLC Mode: Host Default: 254

Parameters:

Effective only when non-0 **MYDLCNUM**, this parm tells the TNC what the DLC address is of the host (ex, MTHOST). Default is 254.

DIGIPEAT ON|OFF Mode: Packet Default: ON

Parameters:

ON The MFJ TNC will digipeat packets if requested.

OFF The MFJ TNC will not digipeat packets.

When this parameter is ON, any packet received that has your TNC's callsign (including SSID) in the digipeat list of its address field will be retransmitted. Each station included in the digipeat list relays the packet in its turn, marking the packet so that it will not accidentally relay it twice (unless so requested), and so that the stations will relay the packet in the correct order. Digipeating takes place concurrently with other MFJ TNC operations and does not interfere with normal operation of a packet station.

In the spirit of cooperation typical of Amateur operation, you will probably want to set DIGIPEAT ON most of the time. However, you might want to disable digipeating if you're not home, or if your transmit relay makes enough noise to wake you up at night.

The command HID enables automatic transmission of identification packets if your station is acting as a digipeater.

DISCONNE Mode: Packet

DISCONNE is an immediate command. It will initiate a disconnect request with the currently connected station. A successful disconnect results in the display of:

*** DISCONNECTED

Other commands may be entered while the disconnect is taking place, although connects are disallowed until the disconnect is completed. If the retry count is exceeded while waiting for the other side to acknowledge, the MFJ TNC moves to the disconnected state. If a disconnect command is entered while the MFJ TNC is

disconnecting, the retry count is immediately set to the maximum number. In either case, the disconnect message is

*** retry count exceeded
*** DISCONNECTED

Disconnect messages are not displayed when the MFJ TNC is in Transparent Mode.

DISPLAY [class] Mode: All

Parameters:

class Optional parameter-class identifier, one of the following:

ASYNC	displays asynchronous port parameters
CHARACTE	displays special characters
ID	displays ID parameters
LINK	displays link parameters
MONITOR	displays monitor parameters
TIMING	displays timing parameters
HEALTH	displays 25 counters*

*The twenty five counters in the MFJ TNC are 16 bits wide, and are ALWAYS initialized to 0000 on power up or "RESTART".

ASYFRERR: This is a health counter reflecting the number of hardware-detected asynchronous framing errors. Framing errors are not fatal. They merely indicate that the terminal attached to your MFJ TNC is not configured correctly with regard to AWLEN/PARITY.

ASYQOVER: Records the number of times received- connected packets have been rejected due to insufficient space in the buffer holding the data going to the terminal. No actual data loss occurs, provided the connection remains intact. ASYQOVER counts can be avoided by increasing the speed of the attached RS-232 terminal and/or printer. (SEE also SENTRNR)

ASYRXOVR: Increases when the software does not service the asynchronous receiver in time. Indicates data from the user to the MFJ TNC is being dropped. This error counter should never become non- zero under supported data rates.

BBFAILED: Counts number of times bbRAM checksum was in error.

DIGISENT: Each frame digipeated by the MFJ TNC causes the counter to increase.

HOVRERR: Increases when HDLC receiver is not serviced rapidly enough and data is lost. This counter should never increment at any supported data rate.

HUNDRERR: Increases when the HDLC transmitter is not serviced rapidly enough and frames are aborted. This counter should never be non-zero at any supported data rate.

RCVDFRMR: Increases when Frame reject frames are received from a connected station.

RCVDIFRA: Increases for each reception of an I frame from a connectee.

RCVDREJ: Increases for each reception of an REJect frame from a connectee.

RCVDRNR: Counts the number of AX.25 L2 receiver- not-ready frames received since power-up and during connections. The count may be useful in gauging system throughput.

RCVDSABM: Each received SABM frame addressed to the MFJ TNC causes this counter to be increased by one.

RXABORT: RXABORT is a count of the number of hardware-detected HDLC abort events. A large number of counts is perfectly normal and should not cause concern.

RXCOUNT: Increases when any frame is received with good CRC (or any CRC if HGARBAGE is turned on).

RXERRORS: Increments each time a received frame is thrown out due to it being too short, suffering overrun(s), or it having a bad CRC. Latter occurs only when CRC checking is enabled (i.e. HGARBAGE is OFF). This counter will often increment in the presence of noise.

RXLENERR: RXLENERR counts the number of too-short frames received. The counts are of diagnostic use only and here again, non- zero counts are not a matter of concern.

RXRESYNC: RXRESYNC is a diagnostic health counter recording the number of receiver resynchronizations handled internally to the MFJ TNC. Non-zero counts indicate the attached radio may be either turned off or squelched. Note that in almost every situation your radio must to have its squelch fully opened!

SENTFRMR: Increments each time a Frame reject frame is transmitted.

SENTIFRA: Increases by one each time an I frame is sent.

SENTREJ: Whenever a REJect frame is transmitted, this counter is incremented.

SENTRNR: This health counter tracks the number of times your MFJ TNC has had to send Receiver-Not-Ready (RNR) frames. Non- zero counts may be an indication that the RS-232 terminal or baud rate is too slow.

TXCOUNT: Incremented whenever a frame is correctly transmitted.

TXQOVFLW: Counts how many times frames were disconnected because the outgoing frame queue wastoo small.

TXTMO: This register may accumulate counts as the MFJ TNC successfully recovers from HDLC transmitter timeouts. This is not a useful command for the majority of the users. Default is 0.

The counters just described, and the setting of **HEALLED** are displayed in response to the health inquiry.

DISPLAY is an immediate command, and with no **class** parameter will cause all control parameters and their current values to be displayed. Sub-groups of related parameters can be displayed by specifying the optional parameter-class. Individual parameters can be displayed by entering the parameter name with no options.

DWAIT n Mode: Packet Default: 33

Parameters:

n 0 - 250, Specifying default wait time in 10 ms intervals.

This value is used to avoid collisions with digipeated packets. The MFJ TNC will wait the default wait time after last hearing data on the channel before it begins its own keyup sequence, unless the MFJ TNC is waiting to transmit digipeated packets. This value should be agreed on by all members of a local area when digipeaters are used in the area. The best value will be determined by

experimentation, but will be a function of the keyup time (**TXDELAY**) of the digipeater stations.

This feature is intended to help alleviate the drastic reduction of throughput that occurs on a channel when digipeated packets suffer collisions. It is necessary because digipeated packets are not retried by the digipeater, but must be restarted by the originating station. If all stations specify a default wait time, and the right value of n is chosen, the digipeater will capture the frequency every time it has data to send, since digipeated packets are sent without this delay.

The **DWAIT** timer is defeated (superseded) when the command **ACKPRIORITY** is ON.

ECHO ON|OFF Mode: All Default: ON

Parameters:

ON Characters received from the computer or terminal are echoed `by the MFJ TNC.

OFF Characters are not echoed.

This command controls local echoing by the MFJ TNC when it is in Command or Converse Mode. Local echoing is disabled in Transparent Mode.

If you don't see your input on the display, you should set **ECHO ON**. If you see two copies of every character you type, you should set **ECHO OFF**. If you see the characters you type displayed correctly, you have **ECHO** set correctly**.**

ESCAPE ON|OFF Mode: Packet Default: OFF

Parameters:

ON The <ESCAPE> character ($1B) is output as "$" ($24).

OFF The <ESCAPE> character is output as <ESCAPE> ($1B).

This command specifies the character which will be output when an <ESCAPE> character is to be sent to the terminal. The <ESCAPE> translation is disabled in Transparent Mode.

This command is provided because some terminals, and computer programs that emulate such terminals, interpret the <ESCAPE> character as a special command pre&ix. Such terminals may alter their displays depending on the characters following the <ESCAPE>. If you have such a terminal, you can protect yourself from unexpected text sequences and from other packeteers by setting **ESCAPE ON**.

See also the **MFILTER** command, which allows general character stripping (rather than character translation) in monitored packets.

FIRMRNR ON|OFF Mode: Packet Default: OFF

FIRMRNR controls the handling of busy states by the MFJ TNC. Setting **FIRMRNR ON** improves channel efficiency, but is incompatible with earlier TNC-2 releases. The incompatibility is a result of vague protocol specifications.

FIRMRNR should be always be set **ON** when conversing with network nodes, for example, NET/ROM. In other cases, it is recommended that **FIRMRNR** be left **OFF** unless you can be assured the other TNC you are connected to supports **FIRMRNR**.

FLOW ON|OFF Mode: Packet Default: ON

Parameters:

ON Type-in flow control is active.

OFF Type-in flow control is disabled.

When type-in flow control is enabled, any character entered from the terminal will halt output to the terminal until: (1) a packet is forced (in Converse Mode); (2) a line is completed (in Command Mode); (3) the packet length is exceeded; or (3) the terminal output buffer fills up. Canceling the current command or packet or typing the redisplay-line character will also cause output to resume. Type-in flow control is not used in Transparent Mode.

Setting **FLOW ON** will keep received data from interfering with data entry. If you (and the person you are talking to) wait for a packet from the other end before starting to respond, you can set **FLOW OFF**. Some Bulletin Board programs may

work best with **FLOW OFF**. Some computers with "software UARTs" may be unable to send and receive data at the same time; users of such computers should set **FLOW ON**.

FORWARD (dest bbs,[optional via]) Mode: Packet

FOrward is an immediate command. Messages can be forwarded manually, by command, or automatically. They can also be forwarded hourly or by your local full-service mailbox reverse forward request. When invoked the mailbox initiates a connect to the callsign of the destination BBS. When a connect is established the mailbox will proceed to send your messages. Messages that qualify for forwarding must meet two conditions, they are:

1. Have flags of 'N'ot read
2. Must have a callsign in the @ addresses that are different from MYMCALL.

After forwarding, each message flag is set to 'F' to prevent further forwards. When all messages are forwarded, if the dest bbs supports reverse forwarding (as determined by "$" in its SID) then TNC will attempt to elicit a reverse forward.

For more information on Forwarding and Reverse Forwarding can be found in the Mailbox Features section of this manual.

FRACK n Mode: Packet Default: 3

Parameters:

n 1 - 15, Specifying frame acknowledgment timeout in 1 second intervals.

After transmitting a packet requiring acknowledgment, the MFJ TNC will wait for the specified frame acknowledgment timeout before incrementing the retry counter and sending the frame again. If the packet address includes relay requests, the time between retries will be adjusted to

Retry interval = n * (2*m + 1)

where m is the number of intermediate relay stations.

When a retried packet is sent, a random wait time is added to any other wait times in use. This is to avoid lockups in which two TNCs repeatedly send packets which collide with each other. Frack will also reduce timeouts with multiple digipeaters.

FULLDUP ON|OFF Mode: Packet Default: OFF

Parameters:

ON Full duplex mode is enabled.

OFF Full duplex mode is disabled.

When full duplex mode is disabled, the MFJ TNC makes use of the Data Carrier Detect signal from the modem to avoid collisions, and acknowledges multiple packets in a single transmission with a single acknowledgment. When full duplex mode is enabled, the MFJ TNC ignores the DCD signal and acknowledges packets individually. The latter mode is useful for full-duplex radio operation, such as through OSCAR 10. It should not be used unless both your station and the station you are communicating with are full-duplex stations.

You may find full-duplex mode useful for some testing operations, such as the analog- or digital-loopback tests.

FULLDUP should be ON during digital loopback tests.

HEADERLN ON|OFF Mode: Packet Default: OFF

Parameters:

ON The header for a monitored packet is printed on a separate line from the packet text.

OFF The header and packet text of monitored packets are printed on the same line.

This command affects the display format for monitored packets. If **HEADERLN** is **OFF**, the address information is displayed with the packet:

KV7D>N2WX: Go ahead and transfer the file.

If **HEADERLN** is **ON**, the address information is displayed, followed by the packet text on a separate line:

N2WX>KV7D:
Sorry, I'm not quite ready yet.

If you have set **MRPT ON** or enabled **MSTAMP**, you may wish to set **HEADERLN ON**, as the packet header quickly becomes long enough to fill a screen when these functions are active.

HEALLED ON|OFF Mode: Packet Default: OFF

Parameters:

ON The MFJ TNC will "dither" the CON and STA LEDs.

OFF The MFJ TNC will control the CON and STA LEDs in normally.

This command allows the user to redefine the functions of the two CPU controllable LEDs (i.e. the STAtus and CONnect LEDs).

When **HEALLED** is set **ON**, the two LEDs flash in a seemingly random fashion. At a glance, the user may be able to make a judgment on whether the software has crashed, since the LEDs will probably not flash if the software fails catastrophically.

With **HEALLED** set **OFF**, the LEDs function normally as before.

HID ON|OFF Mode: Packet Default: OFF

Parameters:

ON Enables HDLC identification by a digipeater.

OFF Disables HDLC identification.

This command is used to enable or disable the sending of identification packets by the MFJ TNC. If **HID** is **OFF**, the MFJ TNC will never send an identification packet. If **HID** is **ON**, the MFJ TNC will send an identification packet every 9.5 minutes if the station is digipeating packets. The ID command allows the operator to send a final identification packet if the station is being taken off the air.

An identification consists of an unsequenced I frame whose data field is your station identification. The identification packet is addressed to the "CQ" address set by the **UNPROTO** command. Your station identification is your callsign as set by **MYCALL**, with "/R" appended.

ID Mode: Packet

ID is an immediate command. It will send a special identification packet. **ID** can be used to force a final identification packet to be sent as a digipeater station is being taken off the air. The identification packet will be sent only if the digipeater has transmitted since the last automatic identification.

An identification consists of an unsequenced I frame whose data field is your station identification. The identification packet is addressed to the "CQ" address set by the **UNPROTO** command. Your station identification is your callsign as set by **MYCALL**, with "/R" appended.

KILONFWD ON|OFF Mode: Mailbox Default: OFF

Parameters:

ON Messages forwarded out of Mailbox will be killed after a forwarding process is complete.

OFF Default; Messages forwarded out of the Mailbox are not killed after a forwarding process is completed.

The setting of **KILONFWD** determines whether or not the TNC deletes a message after it has been forwarded. If your Mailbox **RAM** space is critical then you might want to set this command ON. Setting this command to **ON**, could cause problems, because once a message is killed it cannot be recovered.

KISS ON|OFF Mode: Packet Default: OFF

The **KISS** interface is installed in firmware of the MFJ TNC. KISS enables the MFJ TNC to act as a modem for a host computer. Turning **KISS ON** allows the MFJ TNC to run programs such as **TCP/IP** and other programs which use the Serial Link Interface Protocol (SLIP).

Before enabling **KISS**, make sure radio baud rate and terminal baud rate are set to the desired values. The terminal's baud rate that's determined at sign on is the same that will be used for **KISS**.

Once the operating parameters have been selected, set **KISS ON** and then issue a **RESTART** command. The CON and STA LEDs will blink on and off three times to indicate that the MFJ TNC has entered the KISS mode. Now you may call up a TCP/IP, or another host program that can use KISS or "SLIP".

If you are using the KA7Q TCP/IP program and wish to switch to the AX.25 mode of operation, you can issue the command: **param ax0 255**, then press "RETURN". This command must be issued under TCP/IP "net>" prompt and in lower case letters.

Once the MFJ TNC receives the "param ax0 255" command, it turns KISS off and will revert back to ordinary AX.25 mode of operation. When the MFJ TNC is powered on again, it will sign on to the AX.25 operation mode.

If **KISS** is turned **ON** and you have problem revert the MFJ TNC back to normal AX.25 operation with the above procedure, you can also turn **KISS OFF** by removing JMP5 on the mother board. Reinstall JMP5 after a few minutes.

LCALLS **call1[,call2...,call8]** Mode: Packet Default: ""

Parameters:

call **Callsign** list. Up to 8 calls, separated by commas.

Each **callsign** may include an optional sub-station ID specified as -n immediately following the call. This command works in conjunction with **BUDLIST** and allows selective monitoring of other packet stations. These two commands determine which packets will be displayed when you have set **MONITOR ON**. **BUDLIST** specifies whether the callsigns in the list are the ones you want to ignore or, alternatively, are the only ones you want to listen to.

If you want to listen only for packets from a limited list, you should enter your selected list with **LCALLS** and set **BUDLIST ON**.

If you want to ignore packets from a limited list, you should list the **callsigns** to ignore in **LCALLS** and set **BUDLIST OFF**.

"%" and "&" may now be used to clear the LCALLS list.

LCSTREAM ON|OFF Mode: Packet Default: ON

Parameters:

ON The MFJ TNC will translate the character immediately following the STREAMSWITCH character to upper case before processing it.

OFF The MFJ TNC will process the character immediately following the STREAMSWITCH character as it is entered.

When operating multi-connect, the user must enter a stream identifier (default A through J) after the **STREAMSWITCH** character (default |) to select a new logical stream to send data. Normally, the stream identifier must be in upper case, or an error message will result.

When **LCSTREAM** is **ON**, the character immediately following the streamswitch character is converted to upper case before being acted upon. Thus, the case (upper or lower) becomes insignificant. Use of **LCSTREAM** is useful if you are typing in lower case and don't want to be bothered with remembering to switch to upper case when changing streams.

LCOK ON|OFF Mode: Packet Default: ON

Parameters:

ON The MFJ TNC will send lower case characters to the computer or terminal.

OFF The MFJ TNC will translate lower case characters to upper case.

If **LCOK** is **OFF**, lower case characters will be translated to upper case before being output to the terminal. This case translation is disabled in Transparent Mode. Input characters and echoes are not case translated.
If your computer or terminal does not accept lower case characters it may react badly if the MFJ TNC sends such characters to it. This command allows you to translate all lower case characters received in packets, as well as messages from the MFJ TNC, to upper case.

Since echoes of the characters you type are not translated to upper case, you can use this command to make your display easier to read when you are conversing in connected mode. If you and the other station's operator set **LCOK OFF**, you can each type your own messages in lower case and see incoming packets displayed in upper case. It will then be easy to distinguish incoming and outgoing lines.

LFADD ON|OFF Mode: Packet Default: OFF

Parameters:

ON An ASCII line-feed character is appended to the transmission

OFF An ASCII line-feed character is not appended to the transmission

When **LFADD** is **ON** and the ASCII or Packet mode is selected, MFJ TNC will append an ASCII line feed character, **$0A**, to the transmission immediately after a carriage return is sent.

LFADD should usually be switched **OFF** as the vast majority of TNCs (including the MFJ TNC) are configured to automatically go to a new line whenever a carriage return is printed.

Also see: AUTOLF parameter

LFIGNORE ON|OFF Mode: Packet Default: OFF

Parameters:

ON All <LF> characters are ignored.

OFF All <LF> characters will be used.

This command controls whether MFJ TNC responds to ASCII Lind Feed (<LF> $OA) characters or ignores them in command and converse modes.

When turned on, line feeds are totally ignored except in transparent mode.

MAILBOX ON|OFF Mode: Packet Default: ON

When the **MAILBOX** command is set to **ON**, all of the mailbox functions are active. Note that the **MAILBOX** is a single- user device; therefore, if you wish to use the **MAILBOX** it is necessary for you to set **USERS 1** and select stream A. Note that these are the default settings and selections, respectively. However, as we mentioned in Chapter 5, the Mailbox has been significantly improved. For more extensive information on the new improved Mailbox, please refer to Chapter 5.

If you wish to have your messages time and date stamped, then make sure that DAYTIME is set with the correct time or else each message entered without DAYTIME will not be shown.

A basic explaination of the Mailbox commands are as follows:
K Kills all messages addressed to you, depending on the setting of

the Y flag.

K ## Kills the message in slot nn, depending of the setting of the Y flag. Remote users may only kill message addressed to them or originated by them. the local SYSOP,however, can kill all messages.

L Lists the all messages in Mailbox. Listed messages will contain the slot number, originator, destination, and subject field of all currently used slots.

R Allows you to Read only the messages which are addressed to you.

R ## Allows Reading of a message in a particular slot number.

S call Lets you Send a message to the specified callsign. "Call" must be a callsign valid under the same format as the MYCALL, CONNECT and other callsign commands.

SP call Lets you Send a personal message to the specified callsign. This is a private message which can only be read by the originating station, the station which it is addressed to and the mailbox SYSOP.

B Logout: Initiates a disconnect sequence from the mailbox.

Edit This allows you to Edit the message headers for a Forwarding or Reverse Forwarding process.

J This function when initiated responds with the TNC's MHeard list. This list will contain the eleven most recently heard stations.

M This will let a remote user switch memory banks in the Mailbox RAM.

T When this command is initiated will allow a remote user to PAGE the SYSOP.

H(elp) Displays the mailbox command list, with a brief description of commands, available to the user.

MAILLED ON|OFF Mode: Packet Default: ON

Parameters:

ON The STA led serves as a Mail present indicator and performs normal functions.

OFF The STA led only performs it's normal functions.

When **MAILLED** is **ON**, the MFJ TNC's STA LED will not flash while the Mailbox is ON. However, the STA LED will flash if mail is present in the Mailbox for the SYSOP. The STA LED reverts to its normal function, lit when unacknowledged packets are pending, if the MFJ TNC is in a CONNECTED state, or if **MAILLED** is **OFF**.

MALL ON|OFF Mode: Packet Default: ON

Parameters:

ON Monitored packets include both "connected" packets and "unconnected" packets.

OFF Monitored packets include only "unconnected" packets.

This command determines the class of packets which are monitored. If **MALL** is **OFF**, only otherwise eligible packets (as determined by the **BUDLIST** and **LCALLS** commands) sent by other TNCs in the unconnected mode are displayed. This is the normal manner of operation when this MFJ TNC is being used to talk to a group of TNCs all of which are unconnected.

If **MALL** is **ON**, all otherwise eligible frames are displayed, including those sent between two other connected TNCs. This mode may be enabled for diagnostic purposes or for "reading the mail."

MAXFRAME n Mode: Packet Default: 4

Parameters:

n 1 - 7, Signifying a number of packets.

MAXFRAME sets an upper limit on the number of unacknowledged packets which the MFJ TNC can have outstanding at any one time. This is also the maximum number of contiguous packets which can be sent during any given transmission. If some, but not all of the outstanding packets are acknowledged, a smaller number may be transmitted the next time, or new frames may be included in the retransmission, so that the total unacknowledged does not exceed n.

If you perform file transfers, you should experiment with **MAXFRAME** and **PACLEN**. If the link is good, there is an optimum relationship between the parameters set by these commands so that the maximum number of characters outstanding does not exceed the packet receive buffer space of the MFJ TNC receiving the data.

MCOM ON|OFF Mode: Packet Default: OFF

Parameters:

ON Connect, disconnect, UA, and DM frames are monitored.

OFF Only information frames are monitored.

This command enables monitoring of connect and disconnect frames when **MONITOR** is **ON**.

When **MCOM** is **OFF**, only I frames (packets containing user information) will be displayed. When **MCOM** is **ON** four protocol packets will also be displayed. Connect, disconnect, UA, and DM packets that are monitored are indicated by **<C>**, **<D>**, **<UA>**, and **<DM>**, respectively. As with other monitor commands, the stations monitored are determined by **BUDLIST** and **LCALLS**.

Path for SABM received while in link-setup state is not checked.

MCON ON|OFF Mode: Packet Default: ON

Parameters:

ON Monitor mode remains active when MFJ TNC is connected.

OFF Monitor mode is off while the MFJ TNC is connected.

If **MCON** is **ON**, the **MONITOR** command will enable monitoring while your MFJ TNC is connected to another TNC. If **MCON** is **OFF**, the display of monitored packets is suspended when a connect occurs, and is resumed when the TNC is disconnected.

If you want to see all packets displayed when you are not connected but have such display suppressed when you connect to another station, you should set **MCON OFF**.

MCTEXT Mode: Mailbox Default: " "

Text: Any combination of characters and spaces, up to 120 characters in length.

This command works like **CTEXT** except that **MCTEXT** is sent only when the mailbox MYMcall is connected to. There is no express equivalent to the **CMSG ON/OFF** command. If MCText is empty, no string is sent. If the is message longer than 120 characters an error message will be given and the command is ignored.

The command string can be cleared by typing the command, and then entering the % sign where the text would normally be entered. Also the **RESET** command will empty the **MCT**ext command.

For example you might want to set your MCText to:

Welcome to the Mailbox... I'm not here right, but feel free to use the system...Enjoy!

MFILTER **n1,[n2],[n3],[n4]** Mode: Packet Default: none

Parameters:

n 0 - $7F, Specifying an ASCII character code. Up to 4 characters may be specified.

This command allows you to specify characters to be "filtered," or eliminated from monitored packets. The parameters **n1**, **n2**, etc., are the ASCII codes for the characters you want to filter. You can enter the code in either hex or decimal.

For example, if a <CTRL-L> character causes your screen to be cleared, and you don't want this to happen, you can set **MFILTER 12**. If you also want to eliminate <CTRL-Z> characters, which some computers interpret as end-of-file markers, you can set **MFILTER 12**,**26**.

MHCLEAR Mode: Packet

MHCLEAR is an immediate command. It causes the list of stations heard to be cleared. You can use this command in conjunction with **MHEARD** to keep track of the stations on the air over a given period of time, such as an evening or a week. Clear the list of stations heard when you first begin to monitor the packet activity.

MHEARD Mode: Packet

MHEARD is an immediate command. It causes the MFJ TNC to display the list of stations that have been heard since the last time the command **MHCLEAR** was given. Stations that are heard through digipeaters are marked with a * in the heard log. If you clear the list of stations heard at the beginning of a session, you can use this command to easily keep track of the stations that are active during that period. The maximum number of heard stations that can be logged is 18. If more stations are heard, earlier entries are discarded. Logging of stations heard is disabled when **PASSALL** is **ON**.

If the **DAYTIME** command has been used to set the date and time, entries in the heard log will be time stamped. For example,

cmd:**MHEARD**

```
K4NTA*      06/09/85  21:08:19
WA4ITD*     06/09/85  21:08:17
W1BEL-2*    06/09/85  21:06:18
K4NTA-2*    06/09/85  20:57:35
N2WX
cmd:
```

Note that no daytime string is displayed next to N2WX. This indicates that when N2WX was last heard the clock had not been set.

MYDLCNUM Mode: Host Default: 0

Parameters:

Set to a non-0 number < 255 (TNCs should start at 1; hosts should start at 254 and go down). When set to a non-0 value, the addressing procedures for multiplexing TNCs on the RS232 port are enabled.

MODE Mode: All

MODE is a immediate command. The **MODE** command selects which mode the MFJ TNC will be operating in. The **MODE** command is followed by two characters which denote the mode selected. See Chapter 4 for a more detailed discussion of the **MODE** command.

MNONAX25 ON|OFF Mode: Packet Default: OFF

MNonax25 is defaulted to OFF. When **MNonax25** is OFF the display of non-AX.25 packets is inhibited. MFJ TNC will display only AX.25 packets. Setting **MNonax25** ON will cause MFJ TNC to also monitor non-AX.25 packets, for example those associated with TCP/IP and NET/ROM or THENET links. Display of non-AX.25 packets may not be understandable to the user.

MNONPRIN ON|OFF default: ON

Parameter:

ON Enables printing Non-Printable Characters

OFF Discards all Packets containing Non-Printable Characters

The setting of the **MNONPRINT** parameter determines whether monitored packets containing non-printable characters (i.e., characters other than ASCII CR, LF, BEL, and not between $20 and $7e) are monitored or simply discarded. The default setting permits monitoring all information packets (subject to **LCALLS**, **MONITOR**, **MNONAX25**, etc). When **MNONPRIN** is **OFF**, information packets containing one or more non-printable characters are discarded. You may find this command helpful when there are binary transfers on the channel that you'd rather not monitor. **MNONPRIN** has no effect on data received during connections.

MONITOR ON|OFF Mode: Packet Default: ON

Parameters:

ON Monitoring of all packet activity is enabled.

OFF Monitoring of all packet activity is disabled.

If **MONITOR** is **ON** and the MFJ TNC is not in Transparent Mode, packets not addressed to your MFJ TNC may be displayed. The addresses in the packet are displayed along with the data portion of the packet, e.g.:

N2WX>W5FD-3: I'm ready to transfer the file now.

The calls are separated by a ">" and the sub-station ID field (SSID) is displayed if it is other than 0. The **MALL**, **BUDLIST**, and **LCALLS** commands determine which packets are to be monitored. The **MCON** command controls the action of monitor mode when the MFJ TNC is connected. All monitor functions are disabled in Transparent Mode. If **MONITOR** is **OFF** all packets are still monitored, but only packets addressed to you are printed on the terminal screen.

The format of the monitor display is controlled by **HEADERLN**. If you want to see the station addresses on a separate line from the text, you can set **HEADERLN ON**. **MRPT** enables monitoring of the digipeater route as well as source and destination addresses for each packet. **MSTAMP** includes a time stamp with the addresses if **DAYTIME** has been set.

MRPT ON|OFF Mode: Packet Default: ON

Parameters:

ON Display the stations in the digipeat path for monitored packets.

OFF Display only the source and destination stations for monitored packets.

This command affects the way monitored packets are displayed. If **MRPT** is **OFF**, only the originating station and the destination are displayed for monitored packets. If **MRPT** is **ON**, the entire digipeat list is displayed for monitored packets, and stations that have already relayed the packet are indicated with an asterisk.

For example,

WB9FLW>AD7I,K9NG*,N2WX-7:Hi Paul.

This packet, sent from WB9FLW to AD7I, has been relayed by K9NG but not by N2WX-7. With **MRPT OFF**, the same packet would be displayed as

WB9FLW>AD7I:Hi Paul.

Setting **MRPT ON** increases the length of the address display, and you may wish to set **HEADERLN ON** as well to display this information on a separate line.

MSTAMP ON|OFF Mode: Packet Default: OFF

Parameters:

ON Monitored frames are time stamped.

OFF Monitored frames are not time stamped.

This command enables time stamping of monitored packets. The date and time information is then available for use for automatic logging of packet activity or other computer applications. The date and time are set initially by the **DAYTIME** command, and the date format is determined by the **DAYUSA** command.

Setting **MSTAMP ON** increases the length of the address display, and you may wish to set **HEADERLN ON** as well to display this information on a separate line.

MTIMEOUT n Mode: Packet Default: 30

Parameters:

n 0 - 250, Specifying 10 sec. intervals

If non-zero, this is the timeout value expressed as 10s of seconds. Timeouts on the mailbox apply only to remote users (the SYSOP can never time out). The mailbox will timeout and discon-nect after n*10 seconds of mailbox inactivity. Note that the synchronous 10 second clock may cause the timeout to occur as much as 10 seconds before the calculated timeout time. So, if you want to set your Mailbox timeout to 5 minutes then you set the **MT**imeout command to 30, which would specify a time-out of 300 seconds.

MYCALL **call[-n]** Mode: Packet Default: NOCALL-0

Parameters:

call Callsign of your MFJ TNC.

n 0 - 15, an optionally specified sub-station ID (SSID).

This command tells the MFJ TNC what its callsign is. This callsign will be placed in the **FROM** address field for all packets originated by your MFJ TNC. It will accept frames with this callsign in the **TO** field and relay frames with this callsign in the digipeat field. **MYCALL** will also be used for identification packets (see HID and ID).

The default **callsign** must be changed for proper operation of the protocols. There should never be more than one station with the same **callsign** (including SSID) on the air at once. The SSID can be used to distinguish two stations with the same Amateur call. The SSID will be 0 unless explicitly set to another value.

MYALIAS **call[-n]** Mode: Packet Default: <blank>

Parameters:

call Alternate identity of your MFJ TNC.

n 0-15, an optionally specified sub-station ID (SSID).

This command specifies an alternate **callsign** (in addition to the callsign specified in **MYCALL**) for use as a digipeater only.

In some areas, wide coverage digipeaters operators have changed the callsign of their machine to a shorter and (usually) easier to remember identifier. International Civil Aviation Organization (ICAO) airport identifiers, sometimes combined with telephone area codes, have been used.
Use of this command permits **HID** to identify normally with the **MYCALL**-specified callsign yet permit an alternate (alias) repeat-only "callsign."

MYHIERAD Mode: Mailbox Default: " "

Text Any combination of characters and spaces, up to 60 characters in length.

You may use this parameter to generate a customized "@:" portion of the tagline your TNC will insert in forwarded messages. If **MYHIERAD** is blank, the default @ portion will read "@:<mymcall>". It is suggested that you insert your hierarchical address, location, and zip/postal code in this parameter. Example: MYHIER for N2WX in Sebastian Florida in the Melbourne LAN at zipcode 32958, using N5AUV as the home bbs, would be entered like this:

cmd:MYHIERN5AUV.#MLBFL.FL.USA.NA[N2WX User/Sebastian] Z:32958

-and the tagline would look like this

"R:920801/1200 @:N5AUV.#MLBFL.FL.USA.NA [N2WX User/Sebastian] Z:32958 #:8"

MYMCALL **[callsign]** Mode: Mailbox Default: blank

This is the dedicated callsign for the mailbox. If **MYMCALL** equals **MYCALL**, the TNC responds to incoming connections in mailbox mode. When there is no callsign put in **MYM**call, the mailbox is inaccessible to remote users.

NEWMODE ON|OFF Mode: Packet Default: OFF

Parameters:

ON Switching to data transfer mode occurs at the time of the CONNECT command and return to command mode is automatic at the time of disconnection.

OFF Switching to data transfer mode occurs at time of connection and no return to command mode occurs at disconnection.

The **NEWMODE** command may be used to select the way the MFJ TNC behaves when connections are made and broken.

If **NEWMODE** is **OFF**, the MFJ TNC will remain in Command Mode after you issue a **CONNECT** command until a connection is actually established. When the connection is established, the MFJ TNC will enter Converse Mode or Transparent Mode, depending on the setting of **CONMODE**. When the connection is terminated, the MFJ TNC remains in Converse or Transparent Mode unless you have forced it to return to Command Mode. This is the same as the behavior of TNC 1 (running version 3.x software) under these conditions.

If **NEWMODE** is **ON**, the MFJ TNC will enter Converse Mode or Transparent Mode as soon as you issue a **CONNECT** command, without waiting for the connection to be established. Anything you type will be packetized to be transmitted once the connection is complete. When the connection is broken, or if the connect attempt fails, the MFJ TNC will return to Command Mode.
Bulletin board systems, compatibility with TNC 1

If you have a Bulletin Board program designed to work with TNC 1 you should set **NEWMODE OFF** if the program relies on the sequence of actions used by TNC 1. Otherwise, you should choose the setting for **NEWMODE** that seems most convenient to you.

NODEFORW Mode: Mailbox Default " "

node [via x...], up to 8 vias.

This is an immediate command. It is similar to the **FORWARD** command except that the **NODEFORW** parameter is the callsign+via path to your NETROM, THENET, or KA node. When your TNC establishes the connection to the 'node', it sends the text in **NODEPATH** to establish a network link to the receiving BBS.

If all goes well, the forwardee will send its signon string, and forwarding will commence. To detect failure, **NODEFORW** looks for two strings - "BUSY" and "RETR" - as node connection failure indications. Upon finding "BUSY" or "RETR", the forward attempt is considered failed, and the TNC disconnects from the node. The command can contain the callsign of the "node" and up to 8 vias.

NODEPATH Mode: Mailbox Default:" "

Enter the command the TNC will issue to command the node connected by the **NODEFORW** command to link with the receiving BBS.

Example:

```
cmd:NODEPATH C KB4VOL
cmd:NODEFORW PSL5
```

This sequence first connects to the PSL5 node. When connected, the TNC sends the node connect command "C KB4VOL" to establish a link with the receiving bbs, KB4VOL.

NOMODE ON|OFF Mode: Packet Default: OFF

Parameters:

ON The MFJ TNC will only switch modes (command, converse or transparent) upon explicit command.

OFF The MFJ TNC will switch modes in accordance with the setting of NEWMODE.

When **NOMODE** is **ON**, the MFJ TNC will never change between **CONVERSE** or **TRANSPARENT** mode to **COMMAND** mode (or vice-versa) on its own. Only user commands (**CONV**, **TRANS**, or **^C**) may change the type in mode.

If **NOMODE** is **OFF**, then automatic mode switching is handled according to the setting of the **NEWMODE** command.

NUCR ON|OFF Mode: Packet Default: OFF

Parameters:

ON <NULL> characters are sent to the terminal following <CR> characters.

OFF <NULL> characters are not sent to the terminal following <CR> characters.

This command causes transmission of <NULL> characters (ASCII code $00), producing an effective delay following any <CR> sent to the terminal. The number of <NULL> characters is determined by the command **NULLS**. This delay is required by some hardcopy terminals. You need to set **NUCR ON** if your terminal misses one or more characters after responding to a <CR>. If this is the case, you will sometimes see overtyped lines.

NULF ON|OFF Mode: Packet Default: OFF

Parameters:

ON <NULL> characters are sent to the terminal following <LF> characters.

OFF <NULL> characters are not sent to the terminal following <LF> characters.

This command causes transmission of <NULL> characters (ASCII code $00), producing an effective delay following any <LF> sent to the terminal. The number of <NULL> characters is determined by the command **NULLS**. This delay is required by some display terminals. You need to set **NULF ON** if your terminal sometimes misses characters at the beginning of the line.

NULLS **n** Mode: Packet Default: 0

Parameters:

n 0 - 30, Specifying the number of <NULL> characters to send after <CR> or <LF>.

This command specifies the number of <NULL> characters (ASCII code $00) to send to the terminal after a <CR> or <LF> is sent. In addition to setting this parameter value, **NUCR** and/or **NULF** must be set to indicate whether nulls are to be sent after <CR>, <LF>, or both. Devices requiring nulls after <CR> are typically hard-copy devices requiring time for carriage movement. Devices requiring nulls after <LF> are typically CRTs which scroll slowly. Extra null characters are sent only in Converse and Command Modes.

PACLEN n Mode: Packet Default: 128

Parameters:

n 0 - 255, Specifying the maximum length of the data portion of a packet. The value 0 is equivalent to 256.

The MFJ TNC will automatically transmit a packet when the number of input bytes for a packet reaches n. This value is used in both Converse and Transparent Modes.

If you perform file transfers, you should experiment with both **MAXFRAME** and **PACLEN**. If the link is good, there is an optimum relationship between the parameters set by these commands so that the maximum number of characters outstanding does not exceed the packet receive buffer space of the MFJ TNC receiving the data.

> **NOTE**: Although there is no requirement for two TNCs exchanging data to have the same **PACLEN** value, allowing more than 128 characters of data in a packet may be incompatible with some varieties of TNCs.

PACTIME E|AFTER **n** Mode: Packet Default: AFTER 10

Parameters:

n 0 - 250, Specifying 100 ms intervals.

EVERY Packet timeout occurs every n*100 milliseconds.

AFTER Packet timeout occurs when n*100 milliseconds elapse with no input from the computer or terminal.

This parameter is always used in Transparent Mode, and will also be used in Converse Mode if **CPACTIME** is **ON**. When **EVERY** is specified, input bytes are packaged and queued for transmission every n*100 ms. When **AFTER** is specified, bytes are packaged when input from the terminal stops for n*100 ms. In no case will a zero length packet be produced, and the timer is not started until the first byte is entered. A value of 0 for n is allowed, and causes packets to be generated with no wait time.

PARITY **n** Mode:All Default: 0 (none)

Parameters:

n 0 - 3, Selecting a parity option from the table below.

This command sets the parity mode for terminal or computer data transfer according to the following table:

n	**Parity**
0	no parity
1	odd parity
2	no parity
3	even parity

The parity bit, if present, is automatically stripped on input and not checked in Command Mode and Converse Mode. In Transparent Mode, all eight bits, including parity if any, are transmitted in packets. If "no parity" is set and **AWLEN** is 7, the eighth bit will be set to 0 in Transparent Mode.

PASS n Mode: Packet Default: $16 <CTRL-V>

Parameter:

n 0 - $7F, Specifying an ASCII character code.

This command selects the ASCII character used for the "pass" input editing command. The parameter n is the ASCII code for the character you want to type in order to include the following character in a packet or text string. You can enter the code in either hex or decimal.

You can use this character to send any character in packets, even though that character may have some special function. For example, suppose you have set **COMMAND 3**, specifying that <CTRL-C> is your Command Mode entry character. If you use a Bulletin Board program that requires a <CTRL-C> to escape from some operation, you will type

<CTRL-V> <CTRL-C>

to insert a <CTRL-C> character in your packet. Of course, if you do this frequently you would be better off to change your Command Mode entry character.

A common use for the pass character is to allow <CR> to be included in the **BTEXT** and **CTEXT** messages. Similarly, you can include <CR> in text when you are in Converse Mode, to send multi-line packets. (The default send-packet character is <CR>.)

PASSALL ON|OFF Mode: Packet Default: OFF

Parameters:

ON MFJ TNC will accept packets with invalid CRCs.

OFF MFJ TNC will only accept packets with valid CRCs.

This command causes the MFJ TNC to display packets received with invalid CRC fields. Packets are accepted for display despite CRC errors if they consist of an even multiple of 8 bits and up to 339 bytes. The MFJ TNC will attempt to decode the address field and display the **callsign(s)** in the standard monitor format, followed by the text of the packet.

This mode is not normally enabled, since rejection of any packet with an invalid CRC field is what insures that received packet data is error-free. This mode might be enabled for testing a marginal RF link or during operation under other unusual circumstances.

If you set **PASSALL ON** and monitor a moderately noisy channel you will periodically see "packets" displayed in this mode, since there is no basis for distinguishing actual packets received with errors from random noise.

Logging of stations heard (for display by **MHEARD**) is disabled whenever **PASSALL** is **ON**, since the callsigns detected may be incorrect.

RECONNECT **call1 [VIA call2[,call3...,call9]]** Mode: Packet

Parameters:

call1 Callsign of TNC to be reconnected to.

call2 Optional callsign(s) of TNC(s) to be digipeated through. As many as eight digipeat addresses can be specified.

RECONNECT is an immediate command. It may be used to change the path through which you are currently connected to a station. It may only be used when your MFJ TNC is connected on the current stream to the station you wish to **RECONNECT** to.

Integrity of frames in flight between your station and the **RECONNECT**ed station at the time of **RECONNECT** is not assured.

REMSYSOP **call[-n]** Mode: Mailbox Default: Blank

Parameters:

Call Callsign to be used for Remote SYSOP ops

-n 0 - 15, optionally specified sub-station ID (SSID)

Entering a callsign here permits the owner of the call to perform sysop functions remotely. Sysop functions include editing, reading, and killing any mailbox message. When this parameter is blank, the remote user may only read non- P messages and messages to or from himself. Furthermore, he may only kill messages to or from himself plus any messages of type "T"(raffic).

This parameter may be reset to the blank (no remote sysop) state by entering a "%" or "&" blanking code.

RESTART Mode: All

RESTART is an immediate command. It re-initializes the MFJ TNC using the commands previously set by the user, and stored in **bbRAM**. The effect of this command is the same as turning the MFJ TNC **OFF** then **ON** again.

RESTART does not cause a reset of the parameters in bbRAM. See also the **RESET** command.

REDISPLA **n** Mode: All Default: $12 <CTRL-R>

Parameters:

n 0 - $7F, Specifying an ASCII character code.

This command is used to change the redisplay-line input editing character. The parameter **n** is the ASCII code for the character you want to type in order to redisplay the current input line. You can enter the code in either hex or decimal.

You can type this character to cause the MFJ TNC to retype a line you have begun. When you type the redisplay-line character, the following things happen: First, type-in flow control is temporarily released (if it was enabled). This displays any incoming packets that are pending. Then a <BACKSLASH> character is typed, and the line you have begun is retyped on the next line. If you have deleted and retyped any characters, only the final form of the line will be shown. You are now ready to continue typing where you left off.

You can use the redisplay-line character to see a "clean" copy of your input if you are using a printing terminal and you have dele4ed characters. If you have set **BKONDEL OFF**, deletions are designated with <BACKSLASH> characters, rather than by trying to correct the input line display. The redisplayed line will show the corrected text.

You can also use this character if you are typing a message in Converse Mode and a packet comes in. You can see the incoming message before you send your packet, without canceling your input.

RESET Mode: All

This is an immediate command. When invoked, it **resets all parameters to their default settings** and re-initializes the MFJ TNC.

WARNING: All parameter customizing and monitor lists are lost.

If you just need to re-initialize the MFJ TNC using the parameter values in battery backed-up RAM, you can just turn the MFJ TNC **OFF** then **ON** again rather,than using this command.

RESPTIME **n** Mode: Packet Default: 5

Parameters:

n 0 - 250, Specifying 100 ms intervals.

This command sets a minimum delay that is imposed on acknowledgment packets. This delay may run concurrently with default wait set by **DWAIT** and any random wait in effect.

This delay can be used to increase throughput during operations such as file transfer when the sending TNC usually sends the maximum number of full-length packets. Occasionally, the sending TNC may not have a packet ready in time to prevent transmission from being stopped temporarily, with the result that the acknowledgment of earlier packets collides with the final packet of the series. If the receiving TNC sets **RESPTIME** to 10, say, these collisions will be avoided.

RETRY **n** Mode: Packet Default: 10

Parameter:

n 0 - 15, Specifying the maximum number of packet retries.

The protocol allows for retries, i.e., retransmission of frames that are not acknowledged. Frames are re-transmitted n times before the operation is aborted. The time between retries is specified by the command **FRACK**. A value of 0 for n specifies an infinite number of retries. If the number of retries is exceeded, the MFJ TNC goes to the disconnected state (with an informative message if not in Transparent Mode). See also the **FRACK** command.

REVFLIM **call[-n]** Mode: Mailbox Default: " "

Parameters:

Call Callsign of BBS to enable Reverse-forwards

-n 0 - 15, an optionally specified sub-station ID (SSID).

When this parameter is empty, the mailbox reverse forwards all of its messages eligible for forwarding to the first SID compatible BBS to elicit a reverse forward with "F>." Since this permissive technique is vulnerable to a malevolent operator who might attempt to connect and force your mailbox to forward to him, the **REVFLIM** parameter is provided to limit your mailbox's response to other's reverse forward requests. Simply place the callsign of the BBS you wish to enable reverse forwarding to in this parameter to limit remotely-initiated reverse forwarding to
only that callsign.

RXBLOCK ON|OFF Mode: Packet Default: OFF

Parameters:

ON The MFJ TNC will send data to the terminal in RXBLOCK format.

OFF The MFJ TNC will send data to the terminal in standard format.

RXBLOCK is designed for automated operations, such as packet bulletin board stations. It is intended to help such systems discriminate between data received from the connected station and MFJ TNC-generated messages.

Correct operation of **RXBLOCK** is dependent on the **AWLEN** parameter getting set to 8 (bits) since the character FF hex marks the beginning of a received data unit header.

When **RXBLOCK** is **ON**, data from other stations will be sent from the MFJ TNC in the following format:

$FF	L0	L1	PID	DATA

(prefix) (length) (pid) (data)

The fields above are defined as follows:

prefix	$FF	= A character with all 8 bits set
length	L0	= The high order length of the data, length, and pid fields logically ORed with the value $F0
	L1	= The low order length of the data, length, and pid fields
pid	PID	= The Protocol IDentifier byte received for the following data field
data	DATA	=[Optional], variable length data

For best operation it is suggested that parameters like **AUTOLF**, **MFILTER** etc. be set **OFF** in order to prevent uncertainties in the size of the data field.

RXCAL Mode: All IMMEDIATE

RXCAL is an immediate command. When invoked, the MFJ TNC generates test signals (based on **CALSET** -- see below) that are used by the internal tuning software to align the demodulator components.

To use the **RXCAL** feature,

1) Align the modulator components as described in the owners manual.

2) Use the **MODE** command to select the demodulator to be tuned. Make sure **JMP8**, **JMP7** and **JMP4** are installed.

3) Compute: **n** = 9600/Bit Rate

Where the "bit-rate" is the same as the baud rate in packet modes and the baud rate in all other modes. See **CALSET** Adjustment & Location Map for "**n**" value.

4) Type the command "CALSET n". Use the 'n' from step 3

5) Type the RXCAL command.

6) Tune the appropriate trimpot (R79, R113, R114, or R115) until the DCD light is lit fully.

7) Continue tuning this trimpot until the CON and STA LEDs flash either alternately every half second, and/or both light up

8) Return to step 2 until all the demodulators are tuned.

CALSET Adjustment & Location Map

This is a map of the physical locations of the adjustment potentiometers on the MFJ TNC circuit board. They are shown as they appear when looking down on top of the board with the board oriented so that the rear panel connectors are to the left. Information in the boxes is organized as shown below.

PART MODE CALSET #	FREQ / CALSET
DEMODULATOR	

PART MODE H/L	PART MODE H/L
MODULATOR	

R113 HP	R106 HP L	R77 VP H
CALSET 32	2125 247	2200 240
R79 VP	R78 VP L	R119 VB H
CALSET 8	1200 438	2975 177

NOTE! Separate procedure required to do alignment of CW demodulator center frequency.

NOTE! MCW modulator tone is also used for SSTV transmission. However, CW receive through a narrow filter for HF CW operation will require the CW demodulator center frequency to be selected to align with the radio's filter passband. MCW operation on VHF FM will require that both stations have both the modulator tone and demodulator center frequency to the same frequency. Depending on the mode you feel is most important to you, a choice will have to be made that can adversely affect operation on the other modes (SSTV, MCW, or CW).

RVfALWAY ON|OFF Mode: Mailbox Default: ON

Parameters:

ON Initiates forwards and reverse forwards of all forwardable messages.

OFF Mailbox ignores Forward and NODEforw commands.

The setting of **RVFALWAY**(s) controls whether the TNC will initiate forward events (**FORWARD**, **NODEFORW**) in the absence of forwardable messages. If OFF, the TNC will ignore FORWARD and **NODEFORW** commands entered in the absence of forwardable messages. When ON, the TNC runs the event for the sole purpose of eliciting reverse-forwardable messages from the remote BBS.

SCREENLN **n** Mode: All Default: 0

Parameters:

n 0 - 255, Specifying the screen or platen width, in characters, of the terminal.

This value is used to properly format terminal output. A <CR> <LF> sequence is sent to the terminal at the end of a line in Command and Converse Modes when n characters have been printed. A value of zero inhibits this action.

If your computer automatically formats output lines, you should set **SCREENLN 0** to avoid a conflict between the two line formats.

SENDPAC **n** Mode: Packet Default: $0D <CR>

Parameters:

n 0 - $7F, Specifying an ASCII character code.

This command selects the character that will force a packet to be sent in Converse Mode. The parameter **n** is the ASCII code for the character you want to type in order to force your input to be packetized and queued for transmission. You can enter the code in either hex or decimal.

For ordinary conversation, you will probably set **SENDPAC $0D** and **CR ON**. This causes packets to be set at natural intervals, and causes the <CR> to be included in the packet.

If you have set **CPACTIME ON**, you will probably set **SENDPAC** to some value not ordinarily used (say, <CTRL-A>), and set **CR OFF**. This will allow you to force packets to be sent, but will not result in extra <CR> characters being transmitted in the text.

SLOTS **nnn** Mode: Packet Default: 3

Parameter:

nnn 0 - 127, Specified the number of sides on the slot time dice.

This parameter determines how many sides are on the slot time dice. **SLOTS** represents an **n+1** sided dice the TNC "throws" before transmitting. The **SLOTS** command allows any number of slots from 1 thru 127 to be defined.

SLOTS (n)	REMARKS
1	Disables Slotting
2	
4	This should be the default setting
8	Use only if the channel is VERY busy.
16	VERY VERY VERY busy !
32	You get the idea.
64	
128	Might as well print it out & send it in the mail.

The value used on a particular channel should be agreed on by the channel users. Access to the channel will be equitably distributed among all users if everybody is using the same value for the **SL**ots and **DEA**dtime parameters.

The idea is to pick a value large enough that the probability of two queued up stations picking the same value is relatively small. On the other hand, the value chosen should be small enough that most of the time, ONE of the queued up stations will have a significant probability of picking the first available slot. In this way, the channel is reliably arbitrated and at the same time the overhead required for the arbitration is minimized so that overall throughput on the channel is

maintained. The actual value used will depend on the average number of queued up stations there are on the channel during busy periods.

START **n** Mode: All Default: $11 <CTRL-Q>

Parameters:

n 0 - $7F, Specifying an ASCII character code.

This command selects the **User Restart** character, which is used to restart output **from** the MFJ TNC to the terminal after it has been halted by typing the **User Stop** character. You can enter the code in either hex or decimal.

The User Stop character is set by the **STOP** command.

If the **User Restart** and **User Stop** characters are set to $00, software flow control to the MFJ TNC is disabled, and the MFJ TNC will only respond to hardware flow control (CTS).

If the same character is used for both the **User Restart** and **User Stop** characters the MFJ TNC will alternately start and stop transmission upon receipt of the character.

STOP **n** Mode: All Default: $13 <CTRL-S>

Parameters:

n 0 - $7F, Specifying an ASCII character code.

This command selects the **User Stop** character, which is used to stop output **from** the MFJ TNC to the terminal. You can enter the code in either hex or decimal. This is the character you will type to halt the MFJ TNC's typing so that you can read text before it scrolls off your display.

Output is restarted with the User Restart character, which is set by the **START** command.

If the **User Restart** and **User Stop** characters are set to $00, software flow control to the MFJ TNC is disabled, and the MFJ TNC will only respond to hardware flow control (CTS).

If the same character is used for both the **User Restart** and **User Stop** characters the MFJ TNC will alternately start and stop transmission upon receipt of the character.

STREAMCA ON|OFF Mode: Packet Default: OFF

Parameters:

ON Callsign of other station displayed.

OFF Callsign of other station not displayed.

This command is used to enable the display of the connected- to station after the stream identifier. This is particularly useful when operating with multiple connections allowed. It is somewhat analogous to the use of **MRPT** to show digipeat paths when monitoring.

In the example below, the charaters inserted by enabling **STREAMCA**ll are shown in **bold face** type.

|A:**K4NTA**:hi howie
hello ted how goes it?
|B:**WA7GXD**:*** CONNECTED to WA7GXD
|Bmust be a dx record. ge lyle
|Aunreal ted! fl-az no digis!
|B:**WA7GXD**:big band opening...ge

etc.

The same sequence with **STREAMCA**ll **OFF** would look like the following:

|Ahi howie
hello ted how goes it?
|B*** CONNECTED to WA7GXD
|Bmust be a dx record. ge lyle
|Aunreal ted! fl-az no digis!
|Bbig band opening...ge

etc.

Thus, what would have looked like "|B" now appears as "|B:<callsign>:". This option is very useful for human operators trying to operate multiple simultaneous connections. It is probably less useful for "host" operations.

Note that, in the first example, the **STREAMSW**itch characters "|A" and "|B" with no ":" after them were entered by the operator of the TNC to switch streams for his multiple- connect QSO(s). If you intend to operate multiple connections (as opposed to having your "host" computer operate multiple connections), use of this option is recommended.

STREAMDB ON|OFF Mode: Packet Default: OFF

Parameters:

ON Double all received **STREAMSW**itch characters.

OFF Do not "double" received **STREAMSW**itch characters.

This command is used to display received **STREAMSW**itch characters by "doubling" them. The example below illustrates this action.

With **STREAMDB** on, and **STREAMSW**itch set to "|", the following might be displayed from your MFJ TNC:

|| this is a test.

In this case the sending station actually transmitted

| this is a test.

The same frame received with STREAMDBL OFF would be displayed as:

| this is a test.

When operating with multiple connections, this is useful for differentiating between **STREAMSW**itch characters received from other stations and **STREAMSW**itch characters internally generated by your MFJ TNC.

NOTE: The **STREAMSW**itch character must NOT be one of the stream letters (A - J) for this command to function properly.

STREAMSW **n** Mode: Packet Default: $7C < | >

Parameters:

n $FF, usually specifying an ASCII character code.

This command selects the character used by both the MFJ TNC and the user that a new "stream" (connection channel) is being addressed.

The character can be **PASS**ed in **CONVERS** mode. It is **always** ignored as a user-initiated stream switch in **TRANSPARENT** mode, and flows through as data. This means that the outgoing stream can not be changed while "on line" in **TRANSPARENT** mode (you must escape to **COMMAND** mode to switch streams).

For further usage of this character, see the **STREAMDBL** and **STREAMCA** commands.

SYSOP Mode: Packet/Mailbox Immediate command

When the **MAILBOX** is **ON**, the **System Operator** can access the mailbox by typing the immediate command, **SYSOP**. All commands are available to the **SYSOP**. When the **SYSOP** has completed operating the **MAILBOX**, he must return to command mode with "Control-C" (or the current **COMMAND** character) to allow the remote users access to the **MAILBOX**.

TIMEDCMD Mode: Mailbox Default:" "

[string- max 119 chars]

This string in the **TIMEDCMD** parameter is executed as a TNC command whenever the minutes register in the time of day clock equals the value in the **TIMEDMIN** parameter. The string is executed when seconds equals one; execution is deferred while the user is entering a command.

TIMEDMIN **n** Mode: Mailbox Default: 60

Parameters:

n 0 - 60, Specifying 1 minute intervals

The **TIMEDMIN** parameter is compared against the minutes register of the real time clock to determine when the **TIMEDCMD** string is sent to the command interpreter. Setting this parameter to 60 disables the feature. Combined with the **TIMEDCMD** string, the user may configure his TNC to perform hourly automatic forwards and reverse forwards.

TRACE ON|OFF Mode: Packet Default: OFF

Parameters:

ON Trace mode is enabled.

OFF Trace mode is disabled.

This command is used to enable the protocol debugging function. When **TRACE** is **ON**, all received frames will be displayed in their entirety, including all header information. In normal operation you will probably never need this function; however, if you need to report an apparent software bug, we may ask you to provide trace information if possible.

A trace display will appear in four columns on an 80-column display. Following is an example trace display. For comparison, the frame shown in the trace example would be monitored as follows:

KV7B>CQ,KF7B*:this is a test message

The trace display would look like this:

```
byte  ------------------hex display------------------  ---shifted ASCII---  ---------ASCII----------
000:  86A24040 40406096 AC6E8440 4060968C  CQ    0KV7B  0KF  ..@@@@`..n.@@`..
010:  6E844040 E103F074 68697320 69732061    7B  P.x:449.49.0     n.@@...this is a
020:  20746573 74206D65 73736167 650D         .:29:.6299032.         test message.
```

The **byte** column shows the offset into the packet of the beginning byte of the line. The **hex display** column shows the next 16 bytes of the packet, exactly as received, in standard hex format. The **shifted ASCII** column attempts to decode the high order seven bits of each byte as an ASCII character code. The **ASCII**

column attempts to decode the low order seven bits of each byte as an ASCII character code. In a standard AX.25 packet, the callsign address field will be displayed correctly in the shifted ASCII column. A text message will be displayed correctly in the ASCII column. Non-printing characters and control characters are displayed in both ASCII fields as ".". You can examine the hex display field to see the contents of the sub-station ID byte and the control bytes used by the protocol. Protocol details are discussed in Chapter 9.

TRANS Mode: Packet Immediate Command

This is an immediate command. It causes the MFJ TNC to exit from **Command Mode** into **Transparent Mode**. The current link state is not affected.

Transparent Mode is primarily useful for computer communications. In this mode, the "human interface" features such as input editing capability, echoing of input characters, and type-in flow control are disabled. You may find **Transparent** Mode useful for computer Bulletin Board operations or for transferring non-text files. See the discussion of Transparent Mode in Chapter 5.

TRFLOW ON|OFF Mode:Packet Default: OFF

Parameters:

ON Software flow control can be enabled for the computer or terminal in Transparent Mode.

OFF Software flow control is disabled for the computer or terminal

in Transparent Mode.

If **TRFLOW** is **ON**, the settings of **START** and **STOP** are used to determine the type of flow control used in Transparent Mode. If **TRFLOW** is **OFF**, only hardware flow control is available to the computer and all characters received by the MFJ TNC are transmitted as data. If **START** and **STOP** are set to $00, disabling the User Stop and User Restart characters, hardware flow control must always be used by the computer.

If **TRFLOW** is **ON**, and **START** and **STOP** are non-zero, software flow control is enabled for the user's computer or terminal. The MFJ TNC will respond to the User's Restart and User's Stop characters (set by **START** and **STOP**) while remaining transparent to all other characters from the terminal. Unless **TXFLOW** is also **ON**, only hardware flow control is available to the MFJ TNC to control output from the terminal.

TRIES n Mode: Packet Default: NONE

Parameters:

n 0 -15, Specifying the current **RETRY** level on the currently selected input stream.

This command is used to retrieve (or force) the count of "tries" on the currently selected input stream.

When used with no argument: if the MFJ TNC has an outstanding unacknowledged frame, it will return the current number of tries; if the MFJ TNC has no outstanding unacknowledged frames, it will return the number of tries required to obtain an acknowledgment for the previous frame.

If **RETRY** is set to 0, the value returned by issuing a **TRIES** command will always be 0.

This command is useful for obtaining statistics on the performance of a given path or channel. It should be especially useful for automatic optimizing so such parameters as **PACLEN** and **MAXFRAME** by computer-operated stations, such as automatic message forwarding stations using less-than-optimum paths (noisy HF or satellite channels, for example).

When used with an argument, **TRIES** will force the "tries" counter to the entered value. Use of this command to force a new count of tries is **NOT** recommended.

TXDIDDLE ON|OFF Mode: Packet Default: Off

TXDIDDLE determines whether or not the MFJ TNC uses a highly efficient square wave signal in place of flags during the transmitter delay (TXDELAY) period. When **TXDIDDLE** is **ON**, you may select even smaller TXDELAY intervals because the square wave presents four times as many transitions as **TXDIDDLE OFF** does for your connectees' receive synchronization.

TXDIDDLE is defaulted to the **OFF** setting to reflect that the function is inactive. However there are a number of TNCs on the market which claim to be AX.25 compatible, but do not recognize valid AX.25 packets preceded by the TXDIDDLE keyup technique. You may recognize the need to set **TXDIDDLE** OFF, if it appears that the station you're working is unable to successfully receive your packets despite your adequate signal.

This failure of some TNCs to receive **TXDIDDLE**d packets may be a result of some software carrier-detect schemes. All TAPR and derivative TNCs utilizing hardware-generated carrier-detect receive both TXDIDDLEd and **non-**TXDIDDLEd packets with equal efficiency.

Note that when **TXDIDDLE** is OFF, TXDELAYC is irrelevant! Therefore, the actual TXDELAY yielded when TXDIDDLE is OFF is equal to TXDELAY*100ms plus any AXDELAY time.

TXDELAY **n** Mode: Packet Default: 33

Parameters:

n 0 - 120, Specifying 10 ms intervals.

This value tells the MFJ TNC how long to wait after keying up the transmitter before sending data. Some startup time is required by all transmitters to put a signal on the air; some need more, some need less. In general, crystal controlled rigs with diode antenna switching don't need much time, synthesized rigs need time for PLL lockup, and rigs with mechanical T/R relays will need time for physical relay movement. The correct value for a particular rig should be

determined by experimentation. The proper setting of this value may also be affected by the requirements of the station you are communicating with.

Note that the TAPR TNC 1 and other TNCs using the same firmware interpret n in 40 ms intervals. The value of **TXDELAY** on MFJ TNC will thus be 4 times the value used by a TNC 1 user to give the same delay time.

TXDELAYC nnn Mode: Packet Default: 2

Parameter:

nnn 0 thru 255 in 1 ms steps

The time delay between when the MFJ TNC depresses the PTT and when it starts sending packets is specified in terms of how long it takes to send (**TXDELAYC**) characters at the current radio baud rate. **TXDELAYC** controls a new timer that runs after the regular TXDELAY time has expired (see TXDELAY).

High speed radio users will find this command useful because they can select transmit delays much smaller than the 10 ms grains in TXDELAY. For high speed use, set TXDELAY to 0 and set **TXDELAYC** according to the formula below:

$$\textbf{TXDELAYC} = \frac{\text{Radio-PTT-delay-time}}{\text{Time-per-character}}$$

The time-per-character as related to the radio baud rate is as follows:

Baud rate	Time-per-character
9600	83 ms
2400	3.30 ms
1200	6.70 ms
300	26.00 ms

Examples:

1. For a 200 ms 2 meter HT at 1200 baud, **TXDELAYC** is:

$$\textbf{TXDELAYC} = \frac{200\text{ ms}}{6.7\text{ ms}} = 30$$

2. For a 400 ms HF radio at 300 baud, TXDELAYC is:

$$\textbf{TXDELAYC} = \frac{400\text{ ms}}{26\text{ ms}} = 16$$

TXFLOW ON|OFF Mode: All Default: OFF

Parameters:

ON Software flow control can be enabled for the MFJ TNC in Transparent Mode.

OFF Software flow control is disabled for the MFJ TNC in Transparent Mode.

If **TXFLOW** is **ON**, the setting of **XFLOW** is used to determine the type of flow control used in Transparent Mode. If **TXFLOW** is **OFF**, the MFJ TNC will use only hardware flow control and all data sent to the terminal remains fully transparent.

If **TXFLOW** and **XFLOW** are **ON**, the MFJ TNC will use the MFJ TNC Restart and MFJ TNC Stop characters (set by **XON** and **XOFF**) to control input from the terminal. Unless **TRFLOW** is also **ON**, only hardware flow control is available to the computer or terminal to control output from the MFJ TNC.

Note that if the MFJ TNC Restart and MFJ TNC Stop characters are set to $00, hardware flow control will always be selected regardless of the setting of **TXFLOW**.

TXTMO **n** n=0-65535 Mode: Packet Default: 0

TXTMO is a HEALTH counter that registers the number of packet transmitter timeout/recovery events that have occurred since the MFJ TNC was powered up.

TXUIFRAME ON|OFF Mode: Packet Default: ON

TXUIFRAME is used to tell the MFJ TNC what to do with unconnected information left in its buffers. When this parameter is **ON**, all unconnected data are transmitted as "UI" (unconnected) frames.

This command should be **OFF** for bulletin-board stations as it precludes the unnecessary transmission of text that occurs when the BBS user disconnects -and- unacknowledged packets remain.

UNPROTO **call1** Mode: Packet Default: "CQ"

[VIA call2[,call3...,call9]]

Parameters:

call1 **Callsign** to be placed in the TO address field.

call2 Optional digipeater call list, up to eight calls.

This command is used to set the digipeat and destination address fields of packets sent in the unconnected (unprotocol) mode. Unconnected packets are sent as unsequenced I frames with the destination and digipeat fields taken from call1 through call9 options. When no destination is specified, unconnected packets are sent to CQ. Unconnected packets sent from other TNCs can be monitored by setting **MONITOR ON** and setting **BUDLIST** and **LCALLS** appropriately. The digipeater list is also used for BEACON packets (which are sent to destination address BEACON).

USERS n Mode: Packet Default: 1

Parameters:

n	0 - 10,	Specifying the number of active connections that may be established to this MFJ TNC by other TNCs.

USERS affects only the manner in which incoming connect requests are handled, and has no effect on the number or handling of connections you may initiate with this MFJ TNC.

For example,

USERS 0	allows incoming connections onany free stream.
USERS 1	allows incoming connections on stream A only
USERS 2	allows incoming connections on streams A & B
USERS 3	allows incoming connections on streams A, B & C

and so on through USERS 10.

XFLOW ON|OFF Mode: All Default: ON

Parameters:

ON	XON/XOFF flow control is enabled.
OFF	XON/XOFF flow control is disabled and hardware flow control is enabled.

If **XFLOW** is **ON**, the computer or terminal is assumed to respond to the MFJ TNC Restart and MFJ TNC Stop characters set by **XON** and **XOFF**. If **XFLOW** is **OFF**, the MFJ TNC will communicate flow control commands via RTS.

XMITOK ON|OFF Mode: Packet Default: ON

Parameters:

ON Transmit functions are enabled.

OFF Transmit functions are disabled.

When **XMITOK** is **OFF**, transmitting is inhibited. All other functions of the board remain the same, in other words, the MFJ TNC generates and sends packets as requested, but does not key the radio PTT line.

You might use this command to insure that your MFJ TNC does not transmit in your absence if you leave it operating to monitor packet activity. This command can also be used for testing using loopback or direct wire connections when PTT operation is not relevant.

XOFF **n** Mode: All Default: $13 <CTRL-S>

Parameters:

n 0 to $7F, Specifying an ASCII character code.

This command selects the MFJ TNC **Stop** character, which is sent by the MFJ TNC to the computer or terminal to stop input from that device. You can enter the code in either hex or decimal.

This character would ordinarily be set to **<CTRL-S>** for computer data transfers. If you are operating your station in a Converse Mode and there is some chance that you might fill up the MFJ TNC's buffers, you might set this character to <CTRL-G> ($07), which rings a bell on many terminals.

XON n Mode: All Default: $11 <CTRL-Q>

Parameters:

n 0 to $7F, Specifying an ASCII character code.

This command selects the MFJ TNC **Restart** character, which is sent by the MFJ TNC to the computer or terminal to restart input from that device. You can enter the code in either hex or decimal.

This character would ordinarily be set to **<CTRL-Q>** for computer data transfers. If you are operating your station in Converse Mode, and there is some chance that you might fill up the MFJ TNC's buffers, you might set this character to <CTRL-G> ($07), which rings a bell on many terminals.

TNC MESSAGES

This chapter describes the messages your MFJ TNC may produce and the circumstances under which they may appear.

Packet Messages

***:J**
bbRAM:LOAD WITH DEFAULTS
MFJ Enterprises, Inc.
Model MFJ TNC
AX.25 Level 2 Version 2.0
RELEASE X.X.X - DATE - 32K RAM
Checksum XXX
cmd:

This is the sign-on message that appears when you turn ON your MFJ TNC or when you issue the **RESET** command. The release number will be updated whenever the firmware is changed. The checksum is a hex number which you can compare against the correct checksum given for the firmware version you are using.

bbRAM loaded with defaults

This message appears along with the sign-on message above if the battery backed-up RAM checksum verification fails at power-on time, causing the MFJ TNC to load the default parameters from ROM. (This will be the case the first time you turn on your MFJ TNC.)

This message also appears if the MFJ TNC loads the defaults in response to the **RESET** command.

cmd:

This is the Command Mode prompt. When this prompt appears, the MFJ TNC is waiting for you to issue a command. Anything you type after this prompt will be interpreted as a command to the MFJ TNC If a monitored packet hasbeen displayed, the prompt may not be visible, even though you are in Command

Mode. You can type the redisplay-line character (set by **REDISPLA**) to retype the prompt.

was
Whenever you change the setting of one of the MFJ-TNC's parameters, the previous value will be displayed. This confirms that the MFJ TNC properly interpreted your command, and reminds you of what you have done.

too many packets outstanding

This message would appear in response to a **CONVERS** or **TRANS** command, under special circumstances. If you have previously entered packet data, filling the outgoing buffer in Converse Mode or Transparent Mode and then returned to Command Mode. You will be allowed to enter one of these modes when some of the packets have been successfully transmitted.

Mailbox Messages

? Expected bank n....x
This message occurs when you try to switch to an extended Mailbox memory bank which does not exist. For example trying switch to memory bank 8, using the 512K memory extension. Memory bank 8 does not exist, only banks 0 thru 7 are present.

You have new mail!

Upon accessing the mailbox, this message will appear if there are any new messages addressed to you. These will be the messages with the N message flag set. Once the message is read and the Y message is set, this message will not occur.

Message saved
The Message Saved occurs when a Mailbox message is actually stored after pressing the CTRL-Z and ENTER.

Cannot, not yours
This message occurs when a remote user attempts to kill a message which isnot his, or he tries to read personal message by or for someone else. The SYSOP can read or KILL any message in the Mailbox system.

?Mailbox full
This message occurs when either all of the available slots are full, or the actual message space is full. The number of slots and message space for the different mailbox versions are as follows:

Memory size	# Slots	Message Space
STANDARD*	30	2,900 Bytes
32K**	99	32,000 Bytes
128K**	99/Bank	128,000 Bytes
512K**	99/Bank	512,000 Bytes

* Denotes no memory expansion
** Denotes memory expansion of the size specified by the numeric value.

Messages must be Forwarded to destinations, then killed in order to recover Mailbox message space and to eliminate this error message.

Not found

This message occurs when one attempts to read or kill a non-existent message from an empty slot.

None found

A parameterless Kill or Read command. The Mailbox could not find any messages addressed to the user.

No mail

The No Mail message occurs when a Read command with no slot designator is done, but mail does not exist for the remote user.

Command Mode Error Messages

If you make a mistake typing a command to the MFJ-TNC, an error message will be printed. You may see any of the fol- lowing messages depending on the type of error you have made.

?bad

You typed a command correctly, but the remainder of the command line couldn't be interpreted.

?call

You entered a **callsign** argument that does not meet the MFJ TNC 's requirements for **callsign**s. A **callsign** may be any string of numbers and letters, including at least one letter. Punctuation and spaces are not allowed. The sub-station ID, if given, must be a (decimal) number from 0 to 15, separated from the call by a hyphen.

?EH

This message occurs when a command issued is not understood by the MFJ TNC . This will happen if you are in the mailbox or just during standard operation.

?clock not set

This message appears if you give the command **DAYTIME** to display the date and time without having previously set the clock. The **DAYTIME** command sets the clock if it is given with the daytime parameters, and displays the date and time if it is given without parameters.

?EH

The first word you typed is not a command or a command abbreviation.

?not enough

You didn't give enough arguments for a command that expects several parameters.

?not while connected

You attempted to change **MYCALL** or **AX25L2V2** while in a connected or connecting state.

?range

A numeric argument for a command was too large.

?too long

You entered too long a command line, and the line was ignored. This might happen, for example, if you try to enter too long a message with **BTEXT** or **CTEXT**. If you get this message, the previous text entry was not changed.

?too many

You gave too many arguments for a command that expects several parameters. For example, **MFILTER** can have up to 4 arguments.

md:**MFILTER $1B,$0C,$1A,$03,$07**
too many

?VIA
This message appears if you attempt to enter more than one **callsign** for the **CONNECT** or **UNPROTO** commands without being proceeded by the **VIA** keyword.

Link Status Messages

These messages inform you of the status of AX.25 connections your MFJ TNC may be involved in. You can always interrogate the link status by giving the **CONNECT** command without parameters. If you attempt a connection when your MFJ TNC is not in the disconnected state, the MFJ TNC will display the link status but will take no other action. The following messages appear in response to the **CONNECT** command.

Link state is: CONNECTED to call1
IA call2[,call3...,call9]]

This display shows the station your MFJ TNC is connected to and the digipeater route if any. The **callsign** sequence is the same sequence you would enter to initiate the connection.

Link state is: DISCONNECTED

No connection currently exists. You may issue the **CONNECT** command to initiate a connection.

Link state is: CONNECT in progress

You have issued a connect request, but the acknowledgment from the other station has not been received. If you issue a **DISCONNE** command, the connect process will be aborted.

Link state is: DISCONNECT in progress

You have issued a disconnect request, but the acknowledgment from the other station has not been received. If you issue a second **DISCONNE** command, the MFJ TNC will go immediately to the disconnected state.

Link state is: FRMR in progress

The MFJ TNC is connected but a protocol error has occurred. This should never happen when two TAPR TNCs are connected. An improperimplementation of the AX.25 protocol could cause this state to be

entered. The MFJ TNC will attempt to re-synchronize frame numbers with the TNC on the other end, although a disconnect may result. Connects are not legal in this state, and a disconnect will start the disconnect process.

The MFJ TNC will inform you whenever the link status changes. The link status may change in response to a command you give the MFJ TNC (**CONNECT** or **DISCONNE**), a connect or disconnect request packet from another station, a disconnect due to the retry count being exceeded, an automatic time-out disconnect (**CHECK**), or a protocol error.

***** CONNECTED to: call1 [VIA call2[,call3...,call9]]**

This message appears when the MFJ TNC goes from the "disconnected" or "connect in progress" state to the connected state. The connection may be a result of a **CONNECT** command you issued, or of a connect request packet received from another station.

***** connect request:call1 [VIA call2[,call3...,call9]]**

This message indicates that the MFJ TNC has received a connect request from another station which it has not accepted. This can happen if you have set **CONOK OFF** or if you are already connected to another station. When the MFJ TNC types this message it also sends a DM packet (busy signal) to the station that initiated the connect request. If the MFJ TNC rejects a connect request because you have set **CONOK OFF**, you can issue your own request to the station that called.

***** DISCONNECTED**

This message is displayed whenever the MFJ TNC goes to the disconnected state from any other link state. This message may be preceded by a message explaining the reason for the disconnect, below.

***** retry count exceeded**
***** DISCONNECTED**

This message is given if the disconnect was caused by a retry failure rather than by a disconnect request from one of the stations.

***** <callsign> busy**
***** DISCONNECTED**

This message indicates that your connect request was rejected by a DM packet (busy signal) from the other station. The MFJ TNC will reject a connect request if **CONOK** is **OFF**, or if it is already connected to another station, or the connect request is from a station with a totally blank callsign.

frmr frame just sent:
FRMR sent: xxxxxx

The MFJ TNC is connected, and a protocol error has occurred. The MFJ TNC has sent a special FRMR packet to attempt to re-synchronize frame numbers with the MFJ TNC on the other end. The string **xxxxxx** is replaced with the hex codes for the three bytes sent in the information part of the FRMR frame. This message will not appear if your MFJ TNC is in Transparent Mode.

FRMR rcvd:

This message is followed by a display of the FRMR packet received in the trace display format. This format is explained in the **TRACE** command entry. This message will not appear if your MFJ TNC is in Transparent Mode.

*****LINKOUTOFORDER, possible dataloss[opt.daytime stamp]:**

This message indicates failure of a CONPERMed. One or more packet nodes in the link have failed. The time of failure may be appended to this error message if the stamping mode is on.

HARDWARE

This chapter details the specifications and the functional description of the MFJ-TNC hardware design.

MFJ-TNC Specifications

Processor CMOS Z-80A

Clocks Processor master clock input frequency: 4.9152 MHz
User Port Clock: Switch selectable at 16x baud rate.

Memory All memory in industry-standard JEDEC Byte-Wide sockets.

Standard complement of ROM: 64K
1 x 27C512

Standard complement of system AM: 32K
1x 43256C-15L

Standard complement of mailbox RAM: 0K
(expandable to 32K, 128K or 512K)

Serial Port Z8440 SIO/0 port B configured as UART plus low power TTL-to-RS-232C signal level interface.

Baud rates supported: 300, 1200, 2400, 4800, 9600 and 19,200.

Standard female DB-25S (DCE) RS-232C connector 8-pin TTL connector for TTL serial port.

Modem Demodulator: XR2211 PLL demodulator circuit plus related components to receive up to 1200 baud.

Modulator: XR2206 modulator circuit plus related components to produce tones for all modes of operation.

An external modem may be attached by a single con- nector which completely bypasses the on-board modem.

A Tuning Indicator is built in to be used as a tuning aid for HF (MFJ-1274C only).

bbRAM Non-volatile storage of all important operating parameters is accomplished by using a battery backed-up system for the entire 32K bytes of system RAM and all mailbox RAM.

Protocol AX.25 Level 2 is supported. Pre-Version 2.0 support is compatible with earlier TAPR TNCs running 3.x software. Full support of Version 2.0 protocol is provided. Full duplex radio link operation is supported.

Packet Operating Modes Command Mode: accepts commands via user port.

Converse Mode: accepts digital data, transmits and receives packets, permits terminal editing features (character delete, line delete, input packet delete, output packet delete and redisplay input) via special characters trapped by the MFJ TNC. Escape to command mode via special character or BREAK signal. Optional use of packet completion timer as in Transparent mode.

Transparent Mode: accepts digital data, transmits packets via packet completion timer or buffer full only, and receives packets. No local editing features permitted. Escape to command mode via specially timed character sequence or BREAK signal.

Power Required +12 volts DC at 300 mA.

General Description

The MFJ-TNC is based on the Zilog Z80 (tm) family of microprocessor components.

Major electronic devices in the MFJ-TNC include a CPU (Central Processing Unit) for controlling the MFJ-TNC and a SIO (Serial Input/Output) chip for providing serial interface ports to the on-board modem (which connects to your radio) and to the RS-232C or TTL serial terminal port (which connects to your computer or terminal).

The MFJ-TNC also includes two types of memory. ROM (Read Only Memory) stores the program that tells the MFJ-TNC how to implement the AX.25 protocol. Battery backed-up RAM (Random Access Memory) provides a scratch-pad area for temporary data as well as non-volatile storage for operating parameters such as your station call sign. The battery back-up feature enables the MFJ-TNC to "remember" these values when power is off so you don't have to enter them every time you want to operate.

Other integrated circuits are used for functions including clock oscillator, baud-rate generator, memory-space decoder, power supply and voltage inverter, clock recovery, transmit watch-dog timer and modem. Refer to the schematic diagram while reading the following circuit descriptions.

Detailed Circuit Description

Oscillator

U10a, U10b, U10c, R46, R47, R48, C24, C47, C51, and Y1 provide an accurate crystal-controlled oscillator for system timing.

R48 forces inverter U10a into its linear region and provides a load for crystal Y1. Capacitor C47 provides an adjustable reactive element to allow the oscillator's frequency to be precisely set (this precision is not normally required). Inverter U10c buffers the clock for additional stability before driving additional dividers.

Resistor R46 is used to bias "HCT" logic to the proper levels for best oscillator operation; it is not necessary if U10 is an "HC" logic element.

Dividers and Baud-rate Generator

U10e, U10f, U4a, U4b, U1, U30 ad U31 provide clock outputs derived from the oscillator. Electronics switches within U30 and U31 provide all the terminal baud rate and the RF baud rate under software command.

Inverter U10f provides buffering and isolation between the divide-by-two output of counter U4a and the capacitive load presented by the CPU (U22) and the SIO (U21). U10f's input may be at 2.4576 MHz or 4.9152 Mhz. MFJ-TNC operation at the faster clock of 4.9152 MHz. Capacitors C59 and C60 are used to slow the edges of the outputs of U4a, and capacitor C61 is used to slow the edges from U10f, helping to reduce RFI.

Counter U1 is a multiple-stage divide-by-two circuit that divides the signal at its input many times. This allows the switches within U30 and U31 to select the desired signaling (baud) rate to be used for your computer or terminal as well as the radio channel baud rate.

The output from counter U1 at pin 12 provides a real-time clock interval signal for the SIO. During normal operation, the SIO will be programmed to interrupt the CPU on every transition of this 600 Hz signal. This interrupt occurs 1200 times a second, and is used for protocol and calibration timing functions.

Inverter U10e buffers the radio port "16x" baud-rate signal in case it is routed, via modem disconnect J4 pins 11 and 12, to an external modem. If this buffer were not included, reflections from the distant termination might cause counter U1 to generate count errors.

Counter U4b provides a properly scaled clock for the transmit NRZ to NRZI encoder (see Serial Interface, below).

CPU Complex

EPROM U23 provides system ROM for program storage. Selector U12a acts as a ROM decoder, mapping the ROM into the CPU's memory address space beginning at address 0.

Static RAM provides system RAM for temporary scratch-pad storage, message buffers, etc. Also, because the RAM is backed up by a battery and will not lose its contents when the main power is removed, it is used to provide semi-

permanent storage of user-supplied information (such as your callsign). Selector U12b acts as a RAM address decoder, with RAM starting at address 8000 hex.

The sections of CMOS switch U13 are used to insure that the RAM is not selected when main power is removed. This ensures that the contents of the RAM are not accidentally scrambled as the CPU loses power; it also ensures that the RAM is in the "power-down" state for minimum battery power consumption.

Serial Interface

Serial Input/Output (SIO) device U21 provides two channels of serial I/O.

The B SIO channel is used for the computer or terminal interface. Operational amplifier sections U3a, U3b, and U3d act as RS-232C drivers while Schmitt trigger inverters U9a and U9b act as RS-232C receivers. These circuits consume less power than conventional RS-232C drivers and receivers.

The A SIO channel is used for the radio/modem interface and is normally operated as a full duplex HDLC channel for compatibility with the AX.25 protocol specification. Latch U5 and ROM U6 provide a "state machine" for recovering the clock from the received NRZI data. The state machine also converts NRZI data to NRZ for the SIO. Inverter U9c and flip-flop U11a provide NRZ to NRZI conversion for the transmit side of the radio channel. This conversion between NRZ formatted data and NRZI formatted data is necessary because the AX.25 protocol specification requires NRZI operation while the SIO is only capable of NRZ. Jumper JMP11 may be used to bypass the NRZ --> NRZI conversion for use with external modems, if required.

Watch-dog Timer

Inverters U7c, U7d, U7e, and Q10 and Q20 provide a "watch- dog" timer on the transmit key line to ensure that the transmitter does not remain keyed for more than about 30 seconds should the TNC fails. This allows you to leave a station (such as a remote digipeater) on-the-air and unattended without much chance of having a malfunction "lock up" the packet channel. This also helps ensure compliance with FCC regulations regarding unattended station operation.

Jumper JMP4 is provided for testing purposes. When JMP4 is installed, timing capacitor C31 is shunted, disabling the watch-dog timer.

Modem

U16, an XR2206, is a Frequency Shift Keying (FSK) modulator that generates an audio data signal for use by the radio transmitter. Two tones are used, one for each digital level, and these tones may be calibrated via trimpots R77/R78, R105/R106 in conjunction with the on-board calibration support circuitry and software. When the transmitter is not being keyed, transistor Q9 is switched on, thus preventing U16 from producing tones. This allows you to leave a microphone connected to your packet transmitter for voice operation.

R157 is used to set the tone output levels to the transmitter.

U20, an XR2211, provides a Phase Locked Loop (PLL) FSK demodulator. It converts the received audio FSK signals into digital data at standard logic levels. This data is sent to the state machine clock recovery and NRZI to NRZ format conversion circuits. R79 and R113 are used to calibrate the PLL demodulator's free-running frequency which is set midway between the FSK tones being received. These tones are measured by the calibration software and the output signal produced by U8a and U8b, which is a frequency doubling shaping circuit.

Power Supply

Regulator Q3 and associated components provide a +5 volt regulated output for the MFJ-TNC digital logic circuitry. In order to reduce conducted RFI from the digital power source, series inductor L1 is provided. Transistor Q4, in conjunction with CMOS inverters in U14, provides a "power failure" circuit for the battery-backed RAM chips to ensure that RAM is in the "power-down" state when the main power is removed. In addition, this circuit provides the main power- on reset signal via U7f.

Transistors Q5 and Q6 are used to isolate the battery from the +5 volt line when main power is available. R33 protects the lithium battery from overload conditions and provides a convenient means of monitoring battery current drain when the TNC is switched off. JMP5 provides a means of disconnecting the negative side of the lithium battery for MFJ-TNC maintenance.

U2 and associated components form a charge-pump voltage inverter which generates an unregulated negative supply for the RS-232C drivers.

U3c, Q2, CR6 and surrounding components provide a regulated source of -5 volts for the modem chips.

The modem power sources and ground are isolated from digital logic switching noise by inductor L2.

RS-232C Handshaking Protocol

The CTS, DSR and DTR lines of the RS-232C port (J1) are used for hardware "handshaking" protocol to control the flow of data between the terminal (DTE) and the MFJ-TNC (DCE).

The MFJ-TNC always asserts (makes sure) **D**ata **S**et **R**eady (DSR) on J1 pin 6 via resistor R16. Thus, whenever the MFJ- TNC is powered up, it signals to the terminal connected to J1 that the MFJ-TNC is "on line."

The terminal indicates it is ready to receive data from the MFJ-TNC by asserting its **D**ata **T**erminal **R**eady (DTR) output, J1 pin 20. The MFJ-TNC will send data when it has data to send and DTR is asserted. If the terminal is not ready to receive data, it should negate (make false) DTR to the MFJ- TNC . Thus, data flow from the MFJ-TNC to the terminal is controlled by the use of the DTR line. The state of the DTR line is ignored by the software if "software flow control" is enabled in this direction.

The MFJ-TNC asserts its **C**lear **T**o **S**end (CTS) output, J1 pin 5, whenever it is ready to receive data from the terminal. If the MFJ-TNC 's buffers fill, it will negate CTS, signaling the terminal to stop sending data. The MFJ-TNC will assert CTS when it is again ready to receive data from the terminal. Thus, data flow from the terminal to the MFJ- TNC is controlled by the use of the CTS line. The CTS line is always asserted if "software flow control" is enabled in this direction.

Some serial I/O ports do not implement CTS, DTR and DSR handshaking. If these pins are not connected at the terminal end, they will be pulled up (and thus asserted) by resistors at the MFJ-TNC end. However, a non-standard serial connector may use some pins for other purposes, such as supplying power to a peripheral device, so be sure that your system either implements the CTS, DTR and DSR handshake or has no connections to these pins of J1 whatsoever. Note that reference to RS-232C "compatibility" or the presence of a DB-25 type connector does not guarantee that you have a full RS-232C serial port!

The MFJ-TNC supports most standard baud rates from 300 through 9600. The port supports standard parity options as well as 7- or 8-bit character lengths. Setting these terminal parameters is discussed in Chapter 4.

If you want to interface your MFJ-TNC with a device configured as DCE, such as a telephone modem or another TNC, a so-called "null modem" cable may be constructed to interchange the data and handshake signals.

Jumper Functions

The following table lists the function of each jumper on the MFJ-TNC. For normal operation a shorting jumper must be placed on the following connectors: JMP 5; JMP 8; JMP 9 pins 2,3; JMP 13; JMP 18 pins 1,2; JMP 15 pins 2;3 JMP 26 pins 1,2;. Also on the mode disconnect header J4 the following pins need jumpers pins 1,2 11,12 13,14 17,18.

A listing of the jumpers and their functions are listed on the following page.

Table 8-1: Jumper Function

Jumper #	Position	Function
JMP1	Pin 1 & 2	!DCD (RS-232C) stays on
	Pin 2 & 3	!DCD (RS-232C) stays off
	OFF (default)	!DCD reflects connect status
JMP2	Pin 1&2 (default)	4.92 MHz CPU clock
	Pin 2 & 3	2.46 MHz CPU clock
JMP4	ON	disable Tx watch-dog
	OFF (default)	enable Tx watch-dog
JMP5	ON (default)	Lithium battery connected
	OFF	Lithium battery disconnected
JMP7	ON	analog loopback mode
	OFF (default)	normal modem operation
JMP8	ON (default)	demodulator enabled
	OFF	demodulator calibrate
JMP9	Pin 1 & 2	calibrate U16 tones
	Pin 2 & 3 (default)	normal modem operation
JMP10	ON	digital loopback mode
	OFF (default)	normal modem operation
JMP11	LEFT	transmit data NRZ
	RIGHT (default)	transmit data NRZI
JMP13	ON (default)	TTL, RTS enable
	OFF	TTL, RTS disable
JMP17	Pin1 & 2	2400 baud ext. modem clock
	Pin 2 & 3 (default)	9600 baud ext. modem clock
JMP18	Pin 1 & 2 (default)	Enable 19.2K baud termial
		Disable 300 baud terminal
	Pin 2 & 3	Enable 300 baud termial
		Disable 19.2K baud terminal
JMP19	Bottom pair	Enable 32K mailbox RAM
	Middle pair	Enable 128K mailbox RAM
	Top pair	Enable 512K mailbox RAM
JMP20	ON	512K mailbox RAM installed
	OFF(default)	32K or 128K mailbox RAM
JMP23	ON	Enable memory RESET
	OFF(default)	Normal operation
JMP26*	Pin 1& 2(default)	Normal +5Vb bbRAM operation
	Pin 2&3	Real-time clock installed
JMP27	Pins 1&2 (Default)	Baud Rate Switch SW3 Normal
	Pins 2&3	Baud Rate Switch SW3 Bypass
JMPJ	ON	TX audio has flat response
	OFF(default)	TX audio 6db/oct pre-emphasized
JMPK	ON	TX audio loopback to PTT
	OFF(default)	
JMPX	ON(default)	Speaker Transmit Tone Enable
	OFF	SpeakerTransmit Tone Disable
JMPY	ON(default)	Speaker Receive Tone Enable
	OFF	Speaker Receive Tone Disable

JMPZ	ON(default)	Speaker Connect Tone Enable
	OFF	Speaker Connect Tone Disable

* When JMP23 is shorted, it will RESET the MFJ-TNC. This means that all parameters will be reset to the default values. This is the same as removing the bbRAM battery except it is much quicker.

** MFJ offers an optional Real-time clock module (MFJ-43) that can be installed on the MFJ-TNC mother board. This clock keep the MFJ-TNC clock running all the time. You will not have to reset the clock everytime you turn the MFJ-TNC on.

MFJ provides the user with a TTL Level Input/Output port. This port is usable with computers which cannot make use of the Serial Input/Output RS-232c port. Below is the pin out of the TTL port:

J5 Pin #	Pin Function
1	Receive Data
2	Data Carrier Detect
3	Ground
4	Request to Send
5	Transmit Data
6	Data Set Ready
7	Clear to Send
8	Audio In

J5 TTL Port Pin Out

MFJ also provides the user with an External Modem connector. This connector can be used for adding either the MFJ-2400 or MFJ-9600 baud modems. Below is a pin out oft the J14 External-Modem interface connector:

J14 Pin #	Pin Functions
1	-5V
2	+5V
3	Ground
4	Receive Audio

5	Transmit Audio

External Modem Interface Connector - J14

Modem Disconnect Header- J4

The modem disconnect header, J4, on the MFJ-TNC PC board is provided for using an external modem with the MFJ-TNC. This allows use of higher-speed modems, such as 9600 baud, or more sophisticated, higher-performance modems for OSCAR or other uses.

The following information is primarily for those who wish to interface external modems to the MFJ-TNC. Familiarity with modem and serial data channel terms is assumed.

The signals used at connector J4 are at standard TTL interface levels. A TTL high, or 1, is greater than +2.4 volts but less than +5.25 volts. A TTL low, or 0, is less than 0.8 volts but greater than -0.4 volts. **DO NOT connect an RS-232C level modem directly to J4!**

NOTE: The modem disconnect is similar, but not identical to that used in TNC 1. Be very careful about interfacing an external modem using the same cabling you may have prepared for use with TNC 1!

The connector pin-outs are as follows:

Pin 1 Carrier Detect Input

This pin tells the SIO radio port that a valid data carrier has been detected. It should be pulled high when no carrier is detected and low when a carrier is present. This line must be implemented unless the software release notes indicate otherwise. It is normally jumpered to pin 2 when the on-board modem is used.

Pin 2 Carrier Detect Output

This pin is an output from the the on-board modem and satisfies the requirements outlined for pin 1 above. It is normally jumpered to pin 1 when the on-board modem is used.

Pin 3 SIO Special Interrupt Input

This signal is routed to the radio port DCD input pin on SIO U21. This signal is normally used during modem calibration. It may also be used for other

purposes; if so, these functions will be listed in the software release notes. This pin is normally jumpered to pin 4 when the on-board modem is used.

Pin 4 SIO Special Interrupt Generator Output

This signal is an output from the on-board modem. It is normally used for modem calibration only. If it is used for other functions, they will be stated in the software release notes. This pin is normally jumpered to pin 3 when the on-board modem is used.

Pin 5 SIO RTS Output

This signal is used for transmitter activation. The SIO will pull this output low when the MFJ-TNC wants to transmit; otherwise it will remain high. This pin is normally jumpered to pin 6 when the on-board modem is used.

Pin 6 Transmitter Key Input

This signal is an input to the on-board modem. It activates the PTT pin of the radio connector via the watch-dog timer. It should be left high and pulled low only when transmission is desired. This pin is normally jumpered to pin 5 when the on-board modem is used.

Pin 7 CONNECT Status Output

This pin is an output from the SIO. It is normally low and goes high only when the MFJ-TNC is in the connected (error-free) mode with another packet station. Its status is monitored via the CON LED.

Pin 8 Unacknowledged Packets Pending Status Output

This pin is an output from the SIO. It is normally low and goes high only when this MFJ-TNC has unacknowledged packets in its transmit buffer. Its status is monitored via the STA LED.

Pin 9 CTS Input

This pin is an input to the SIO. It is high when the attached modem is not ready to accept data, and low when the attached modem is ready to accept data. The TNC will not attempt to send data when this pin is high. This pin is normally jumpered to pin 10 when the on-board modem is used.

Pin 10 Transmitter Key Input

This pin is physically tied to pin 6, above. It is used in conjunction with pin 9, above to allow the MFJ-TNC to use the on-board modem whenever the transmitter is activated.

Pin 11 Transmitter Clock (16x) Input

This pin is tied to the NRZ-to-NRZI converter, which expects a clock signal at 16 times the desired radio port data rate, e.g., 4800 Hz for 300 baud. This pin is normally jumpered to pin 12 when the on-board modem is used.

Pin 12 Transmitter Clock (16x) Output

This pin is tied to the radio baud rate switch network. It provides a clock at 16 times the desired radio port data rate. This pin is normally jumpered to pin 11 when the on-board modem is used.

Pin 13 Receive Clock Input

This pin is tied to the SIO receive clock input pin. It expects a clock at the desired data rate (1200 Hz for 1200 baud), of the proper phase relationship to the received data. This pin is normally jumpered to pin 14 when the on-board modem is used.

Pin 14 Receive Clock Output

This pin is the received data clock signal derived from the NRZI-to-NRZ state machine. This pin is normally jumpered to pin 13 when the on-board modem is used.

Pin 15 MFJ-TNC Ground Reference

This pin ties to the MFJ-TNC digital ground system, at the SIO.

Pin 16 Turbo LED output

This pin is used to connect the Turbo LED on the mother board to the external modem board. When this pin is high (+5Vdc), the Turbo LED will light.

Pin 17 Receive Data Input

This pin is the received data input to the NRZI-to-NRZ state machine. This pin is normally jumpered to pin 18 when the on-board modem is used.

Pin 18 Receive Data Output

This pin provides receive data from the on-board modem. This pin is normally jumpered to pin 17 when the on- board modem is used.

Pin 19 Transmit Data Output

This line is the NRZ or NRZI (depending on the state of JMP11) data output. This pin is normally jumpered to pin 20 when the on-board modem is used.

Pin 20 Transmit Data Input

This input line accepts data to be be transmitted by the modem. This pin is normally jumpered to pin 19 when the on-board modem is used.

If you elect to use an off-board modem, be sure to properly shield the interconnecting cables for RFI protection.

HF Tuning Indicator

The MFJ-TNC has a built-in tuning indicator for HF operation. It is set for a center frequency of 2210 Hz. The incoming audio frequency is centered at 2210 Hz. This is indicated by one or two of the center most LEDs brightly lit. When you are tuned to a lower center frequency, the LED to the left of center lights. When you are tuned too high, the right of center LED lights. The resolution between each bar segment is approximately 10 Hz.

TROUBLESHOOTING

WARNING: Never remove or insert an IC with power on!

Your MFJ-TNC is a complex piece of electronic equipment. Servicing must be approached in a logical manner. The best preparation for troubleshooting is to study the detailed hardware description in Chapter 7. While it is not possible to present all possible problems, symptoms and probable cures, this section of the manual will give direction to troubleshooting based on our experience.

General Tests

In most cases we have found that careful visual inspection combined with simple measurements generally reveals the problem. The most useful single instrument for troubleshooting is a good DVM that can read AC and DC volts, and can non-destructively test resistance while the ICs are still in their sockets.

While a number of checks may be made without the aid of an oscilloscope, you will need one to check signals at various points on the board if you fail to locate the problem by visual means or with a meter. Be very careful about shorting pins on ICs when applying meter or scope probes to the board. It is a good idea to attach a secure ground lead to the meter or scope, one that won't accidentally short across components on the board. A good place to pick up this ground is on the head of the screws which mount the printed- circuit board to the case.

Step 1: Power Supply

The first thing to check in any malfunction is the power supply. Check the power supply levels at the outputs of the voltage regulators (Q2 and Q3) as well as the output of the inverter (U2). Are they close to their nominal values? Do all the ICs in the suspected area have the proper voltage on their power pins? Is there excessive ripple in any of the DC voltage lines? If so, check the regulator and associated components, working backwards toward the input power switch. If the voltage is low, in conjunction with a hot regulator, suspect a short circuit on the board.

If the problem is in the -5 volt supply, work backwards from Q2's collector (also at U16 pin 1), which should be -5 volts regulated, to the junction of C9 and CR2 (**-V** unregulated). If no voltage appears at **-V**, then U2 or a related component may be at fault. Verify that U2 is oscillating by looking at the wave form at U2

pin 5. If **-V** is more negative than - 7 volts (i.e., normal), but the -5 volt regulated voltage is wrong, check the negative regulator components U3, Q2, R5, R6, R7, R8, CR6, C10, C11 and C158. If both **-V** and the -5 volt regulated voltage are wrong, look for shorts.

Step 2: Obvious Problems

CAUTION: A word of WARNING here. DO NOT touch any component which is suspect of being HOT. This could result in BURNS from the HOT component.

Look for any unusual physical symptoms. Are any components discolored? Does something smell burnt? Do any of the parts seem excessively warm? If you have never had your fingers on operating digital integrated circuits before you may erroneously conclude they are too hot when they are actually operating normally. Take for instance, the Z80 CPU and the Z80 SIO. They generally are warm to the touch. In general their normal temperature will be well below the boiling point of water, but you may not want to keep your finger on them very long.

Step 3: Assembly Problems

Carefully inspect the PC board and component installation. Are any cold solder joints present? Is a metal screw shorting to the board anywhere? Are all ICs firmly seated in their sockets? Are any IC leads tucked under the chip or otherwise bent in such a manner that they aren't making proper contact with the IC socket?

Inspect the diodes and electrolytic capacitors for proper installation. Are the diode cathodes pointing the correct way? Are the negative ends of the electrolytic capacitors pointing the correct way?

Step 4: Cabling Problems

Inspect the interconnection cabling. Does it work on another TNC? Has the radio and/or terminal been successfully used on packet with this or another TNC? Are all the connections tight? Has the cable frayed or broken?

Specific Symptoms

While the steps described above may seem obvious, careful inspection often will point to the problem or give significant clues as to the probable area of the MFJ-TNC most suspect. After the above inspection has been completed and apparent problems are dealt with, it is time to proceed to more specific analysis.

Symptom: TNC appears dead

If the MFJ-TNC powers up with the PWR, STA, and CON LEDs lit, followed by STA and CON extinguishing a second or so later, the processor is working and the software is probably working correctly. You should suspect the terminal port at this point. Check all connections and verify the logic levels according to the terminal interface troubleshooting section in this chapter.

Oscillator and Reset Circuits

If no LEDs cycle ON then OFF during the reset cycle the problem may be more serious. Check to see that the crystal oscillator is working and that an "M1" signal (154 kHz square wave, 0 to +5 volts) is coming from U22 pin 27. The crystal oscillator input to the processor (U22) is pin 6. The input clock should be a (possibly distorted) square wave signal. Verify that the clock input at pin 6 of U22 is running at the correct frequency (near 4.9152 MHz).

Verify that the battery backed-up RAM protection circuit, composed of Q4, U14 and associated devices, is going to +5 volts at U14 pin 6 after input power is applied. This signal enables normal operation of U24 and U25. There should be a logical low on the output of U7 pin 12 coincident with the application of power and lasting for a few hundred milliseconds. Without this RESET signal, the Z80 probably won't start up properly.

Digital Logic Lines

Remember that all of the logic circuits operate at standard TTL levels (a "low" is less than +0.8 V and a "high" is greater than +2.4 volts), and all digital inputs and outputs switch between these two levels. Thus, if you see logic signals switching between 0 and, say, 1 volt, you can be sure there is a problem (usually a short). On the other hand, do not mistake switching transients on digital logic lines for improper operation -- these show up as ringing and other distortions.

Verify that there is activity on the control bus READ and WRITE lines, the 3 CHIP-ENABLE lines on the memories (U23- 25, pins 20), the IOREQ line on

U21 pin 36, and the INT line on pin 16. Each of these lines should show activity, and if any line is quiet this is a sign of trouble.

Logic lines that show no activity may often be traced to a short on the pc board, probably due to a solder splash or bridge.

Address and data line shorts may also show up as lack of activity on the control bus lines, especially the chip selects. Check each of the 16 address and 8 data lines for activity. Any lines showing a lack of activity are not operating properly.

If you suspect problems with address or data lines, try removing all the memory chips. Each address and data line will now show a distinct pattern. The address lines should be (possibly distorted) square waves whose periods increase by a factor of two on successive lines as you step line by line from A0 to A15.

If you decide to use an ohmmeter to check for shorted lines, use a low voltage/low current test instrument. (Most Modern DVMs are fine for this.) If in doubt, remove any ICs connected to the lines you are measuring. If you suspect a short, check the high density areas of the PC board for the problem. In most cases the short will be found there. It is very unlikely that the PC board itself will have a short.

Symptom: Modem won't calibrate or key transmitter.

Troubleshooting improper calibration amounts to checking for proper signals at U21 and following up any improper signal. If the calibration signal is present, but you cannot successfully calibrate the frequency, you may have an out-of-spec frequency determining component. Check the values of the appropriate passive components. Also, check the placement of jumpers! As a last resort, check the signal frequency with a frequency counter. Note that, due to frequency jitter while calibrating the demodulator, the STA and CON LEDs may blink somewhat even when the 1700 Hz demodulator frequency is correct.

Calibration of the demodulator and the modulator tones are discuss in the Appendix chapter.

If the transmitter doesn't key, the problem may be in the watchdog timer, U7, or the PTT transistors, Q10 or . Check especially for an open timing capacitor C31 or a bad solder connection associated with R83.

Symptom: Uncopyable transmitted or received packets

If no one seems able to decode your packet transmissions, it is often the case that your transmitter is being overdriven. The solution is to reduce the drive level via trimpots R157 and . Note that direct connection to typical microphone inputs requires R157 or to be turned to near the minimum signal position to produce sufficiently low signal levels.

If you are having problems hearing other stations, the demodulator circuitry associated with U20 may be at fault. Check the center frequency of the VCO in U20 using the calibration procedure. Working in the direction of flow of the input signal from the radio, verify that it is being passed through to pin 2 of U20, the input pin. The signal there should be above 50 mV and below 3 V peak-to-peak for proper operation of the demodulator. It should be relatively clean, although a few tens of millivolts of noise is normal, and the signal amplitude should not change by more than about 25% between high and low tones.

Note: Make sure that JMP 8 is ON.

Terminal Interface Troubleshooting

If you can't get the MFJ-TNC to sign on and accept data from your terminal or computer, the problem may be in the RS-232C interface. The troubleshooting guide below is provided as an aid to help in resolving problems that may be related to the RS-232C port.

Symptom: MFJ-TNC won't sign on to the terminal.

If you find the MFJ-TNC won't send data to your terminal, one of the first things to do is to verify that the RTS line at pin 4 of J1 is not being held low. If the software flow control option is disabled, the MFJ-TNC will not send data to the terminal unless its RTS is asserted. If the terminal does not implement the RTS/CTS protocol, the RTS/CTS lines (pins 4 and 5 on J1) should remain unconnected.

Verify that the voltages on the MFJ-TNC are correct. If the MFJ-TNC is in otherwise good condition, check the following pins on the SIO, U21 (Z8440). Pin 23 should be TTL low (between 0 and +0.8 volts). If this voltage is incorrect, check the voltage at U9 pin 3 and verify that it is greater than +3 volts. If this voltage is correct, U9 or the traces around it may be bad. If this is not the

problem, disconnect the terminal and check it again. If this doesn't help, U9, R20 or R22 may be at fault.

If the above checks are ok, observe pin 26 of U21 with an oscilloscope and cycle the power switch on the MFJ-TNC . Transitions on this pin shortly after reset indicate that the MFJ-TNC is sending data. Verify that transitions are also present on U3 pin 1. If these tests fail, the fault could be with U13, R25, R26, U21, J1, the attached cable or faulty soldering (shorts, cold joints, etc.)

Symptom: The MFJ-TNC appears to be signing on but only gibberish is printed on the terminal.

This indicates that some combination of the data rate (baud rate), parity option, or number of start and stop bits are not set the same at the MFJ-TNC and at the terminal. If possible, set your terminal to 1200 baud. Also verify that the terminal is set for eight data bits, no parity, and 1 stop bit. These are the default settings stored in EPROM. Perform a hard reset by the power switch OFF then ON (out then in). The sign on message should appear.

If the MFJ-TNC still prints gibberish, verify that the terminal is set to the MFJ-TNC 's baud rate and do a power off then on cycle on both the MFJ-TNC and terminal. If the message still fails to appear try troubleshooting with an oscilloscope, looking first at the TXD pin (pin 26) of U21 (Z8440), then at the x16 baud rate clock (19200 Hz at 1200 baud) on pin 27 of U21.

Symptom: The MFJ-TNC signs on OK but won't accept commands.

After the MFJ-TNC signs on, try giving it a command such as **MYCALL** or any other command. If the default settings are in effect, it will attempt to echo each character you type back to the screen. If it doesn't echo, be sure that U21 pin 23 has a voltage level between 0 and +0.8 volts on it. The voltage on U9 pin 3 should be greater than +3 volts. If these voltages aren't correct, the fault could be in U9, U21, J1, R20, R22, soldering, or the interconnecting cable.

If the above checks are OK, use an oscilloscope to verify that data is present on U21 pin 28 and U9 pin 1 when you strike a key on your terminal. If not, the data isn't getting from your terminal to the MFJ-TNC . Check J1, the cable and U9 again. Finally, be sure that your terminal actually uses levels less than -3 volts and greater than +3 volts for signal levels. 0 and +5 volts may not work, especially if they are being used direct from a computer.

Symptom: The MFJ-TNC appears to have "lock-up" i.e. not responding to any commands.

This may be due to some invalid parameters having been stored in the memory. Try turning the MFJ-TNC off and disconnect JMP 5 on the MFJ-TNC board. This will disconnect the memory back-up circuit and allow the memory to be erased. Re-install JMP 5 after about 2 minutes and try operating again.

PACKET RADIO PROTOCOL

Explanation of Protocol

The material in this chapter is intended to supply an overview of the packet protocol used to transmit data by the TAPR software. The MFJ-TNC employs the **genuine** TAPR TNC 2 packet software. References are given to more detailed information required by those wishing to implement these protocols on other hardware. The material presented below is somewhat tutorial in nature for those who have not had previous exposure to layered network protocols, but it presumes some knowledge of general communications hardware and software. Persons already well versed in networking may want to skip this chapter and refer to the primary defining document, Amateur Packet-Radio Link-Layer Protocol, AX.25 Version 2.0, available from the ARRL, 225 Main Street, Newington, CT 06111 ($8.00 US, postpaid in the United States as of this writing).

The MFJ-TNC hardware and software architecture is organized in accordance with the International Standards Organization (ISO) layered network model. The model describes seven levels and is officially known as the ISO Reference Model of Open Systems Interconnection, or simply the ISO Model. The model and many other interesting topics are discussed in Computer Networks by Andrew S. Tanenbaum.

The ISO model provides for layered processes, each supplying a set of services to a higher level process. The MFJ-TNC currently implements the first two layers, the Physical layer and the Data Link layer.

Physical Layer

The duty of the Physical Layer, layer one, is to provide for the transmission and reception of data at the bit level. It is concerned only with how each bit is physically transmitted, i.e., voltages on a hardwire line or modem tones on phone or RF links.

The physical layer of the MFJ-TNC is described in Chapter 7, Hardware. It is compatible with the various TNCs currently available to radio Amateurs. The actual modem interface is compatible with the Bell 202 standard which is similar to the CCITT V.23 standard. Any other hardware device which is compatible

with the Bell 202 standard should be compatible with the MFJ-TNC, at least at level one of the ISO reference model.

Data Link Layer

The duty of the Data Link layer is to supply an error-free stream of data to higher levels. Since level one simply passes any bits received to level two and is unaware of the content or overlying structure of the data, transmission errors are not detectable at level one. Level two carries the responsibility of detecting and rejecting bad data, retransmitting rejected data, and detecting the reception of duplicate data.

Level two accomplishes this task by partitioning data to be transferred by level one into individual frames, each with its own error detection field and frame identification fields. The MFJ-TNC supports two versions of a level-two layer, AX.25 version 1.0 and AX.25 version 2.0. Each of these protocols is based on HDLC, the **H**igh-Level **D**ata **L**ink **C**ontrol protocol defined by the ISO.

HDLC Frames

Exact knowledge of the format of HDLC frames has been made largely unnecessary by the advent of LSI and VLSI communications chips which interface directly with the level one hardware. The level two software need only supply data to fill in various fields and the chip takes care of the rest. For completeness however, an HDLC frame looks like this:

| FLAG | ADDRESS | CONTROL | PID & DATA | FCS | FLAG |

FLAG A unique bit sequence (01111110) used to detect frame boundaries. A technique called "bit stuffing" is used to keep all other parts of the frame from looking like a flag.

ADDRESS A field normally specifying the destination address. AX.25 uses a minimum of 14 bytes and a maximum of 70 bytes containing the actual call signs of the source, destination, and optionally up to eight digipeaters.

CONTROL A byte which identifies the frame type. In the AX.25 protocol, the control field may include frame numbers in one or two 3-bit fields.

PID A Protocol Identification byte appears as the first byte of the HDLC DATA field in AX.25 Level Two information frames, and identifies which Level

3 protocol is implemented, if any. In the case where no Level 3 protocol is implemented, PID = $F0.

DATA This field contains the actual information to be transferred. This field need not be present. Most frames used only for link control do not have data fields.

FCS Frame Check Sequence, a 16-bit error detection field.

The communications chip recognizes the opening and closing flags and passes the address, control, and data (including PID) fields to the software. The FCS field is a Frame Check Sequence computed by the transmitting chip and sent with the frame. The receiving chip recomputes the FCS based on the data received and rejects any frames in which the received FCS does not match the computed FCS. There is virtually no chance of an undetected bad frame using this method. This satisfies the level two task of bad data detection.

The communications chip used in the MFJ-TNC is a Zilog 8440 SIO operating in conjunction with a two-chip "state machine" which is used to recover the data clock. The transmitted data is encoded in NRZI form, which encodes a "0" data bit as a transition in the encoded bit stream and a "1" data bit as no transition. This, in combination with the "bit-stuffing" which ensures that no more than five "1"s occur in a row except when FLAG bytes are being transmitted, guarantees that a logic level transition occurs at least once every 5 bit times. These frequent transitions allow the receiver to synchronize its clock with the transmitter. Other chips which are compatible with the SIO + "state machine" are the Western Digital 1933/1935, the Intel 8273 (used on the VADCG and Ashby TNCs) and the Zilog 8530 (used on the Xerox 820 FAD adapter).

While the HDLC format supplied by the communications chips is used by the AX.25 protocol, there are several other Layer Two concerns. These are duplicate frame detection, connection and disconnection of the level two layers on different TNCs, and buffer overrun avoidance. The AX.25 protocol solves these problems as described below.

AX.25 Level Two

AX.25 is based on the Balanced Link Access Procedure (LAPB) of the CCITT X.25 standard. LAPB in turn conforms to the HDLC standard. Two extensions are made to LAPB in AX.25. These are the extended address field, and the unnumbered information (UI) frame. In LAPB, addresses are limited to eight bits, while AX.25 uses from 112 to 560 bits, containing the originator's call sign,

the destination call sign and an optional list of one to eight digipeater (simplex digital repeater) call signs.

The UI frame is used to send information bypassing the normal flow control and acknowledgment protocol. The UI frame is not acknowledged but can be transmitted at layer two without fear of disturbing higher layers. It is used for beacon frames, for automatic identification packets, and for sending information frames when the MFJ-TNC is not connected to another TNC, e.g., CQ and QST activities.

The exact specifications for AX.25 are supplied in the ARRL publication Amateur Packet-Radio Link-Layer Protocol, AX.25 Version 2.0. The TAPR implementation adheres to this standard for AX.25 version 2.0. The implementation of version 1.0 is almost identical to the TAPR TNC 1 version of AX.25 protocol in software releases 3.x. This provides compatibility with the majority of Amateur packet radio stations.

The following table lists the frame types used by AX.25 and describes their purpose. This material is provided to give a general understanding of the protocol, and is not intended to replace the published specification. The byte fields are given as they appear in memory after data is received, i.e., the high order bit is at the left and the low order bit is at the right. This is also the format of the display provided by the **TRACE** command. Some texts, including the AX.25 protocol specification, list the bits in the order in which they are transmitted, which is low order bit first.

The control bytes are presented in hex with "x" used to indicate four bits which depend on the acknowledge functions the packet is performing. Usually "x" is a frame number. Frame numbers fit into three bits and are used to ensure that frames are received in order and that no frames are missed. Since only three bits are available, the frame number is counted module 8. This is why the **MAXFRAME** parameter has a ceiling of 7: no more than seven frames can be "in flight" (transmitted but unacknowledged) at one time. A short description of the use of the frames is given after the table.

Code	Abbrv	Frame Type
x1	RR	Receive Ready
x5	RNR	Receive Not Ready
x9	REJ	Reject
03	UI	Unnumbered Information
0F	DM	Disconnected mode
2F	SABM	Connect request
43	DISC	Disconnect request
63	UA	Unnumbered Acknowledge
87	FRMR	Frame reject
even	I	Any frame ending in an even number (including $A, $C, and $E) is an information frame.

Table 10-1 AX.25 Control Codes

I This and UI frames are the only frame types containing user data.The control byte contains this frame's number and the number of the next frame expected to be received from the other end of the link.

RR Usually used to acknowledge receipt of an I frame. The RR function can also be performed by sending an I frame with an updated "expected next frame number" field.

RNR Used when the buffer space on the receiving side is full.

REJ Used to request retransmission of frames starting from "x". Missed frames are detected by receiving a frame number different from that expected.

DM Sent in response to any frame received other than a connect request (SABM) when the TNC is disconnected. Sent in response to an SABM whenever the TNC is on the air but can't connect to the requesting user, e.g., if the TNC is already connected to someone else or if **CONOK** is **OFF**.

SABM Set Asynchronous Balanced Mode initiates a connect.

DISC Initiates a disconnect.

UA Sent to acknowledge receipt of an SABM or DISC.

FRMR Sent when an abnormal condition occurs, i.e., the control byte received is undefined or not proper protocol at the time received. UI frames UI An I frame without a frame number. It is not acknowledged.

Channel Use and Timing Functions

The following discussions mention timing parameters which are set by various commands. These timing functions are also discussed in Chapter 5.

An important part of any packet radio protocol is the means by which many stations make efficient use of an RF channel, achieving maximum throughput with minimum interference. The basis for this time domain multiplexing is **C**arrier-**S**ensed **M**ultiple **A**ccess (CSMA) with collision detection and collision avoidance.

CSMA means simply that (as every Amateur knows) no station will transmit if the frequency is in use. The MFJ-TNC continually monitors for the presence of an audio data carrier on frequency and transmits only if there is no carrier. (The RF carrier is not normally detected; however, an input is available on the MFJ-TNC radio interface connectors to allow such an input.) In order to make detection of a busy channel more reliable, the MFJ-TNC sends an audio signal (continuous flags) any time the transmitter is keyed and a packet is not being sent, as during the transmitter keyup delay (**TXDELAY**), or while a slow audio repeater is being keyed (**AXDELAY**).

By itself, CSMA is not enough to insure a minimum, or even low, interference rate, due to the likelihood of simultaneous keyup by two or more stations. This is where collision detection and collision avoidance come in. The MFJ-TNC detects a collision by the absence of an ACK from the station it is sending to. The receiving station does not acknowledge the frame that suffered the collision, since either the FCS was incorrect or the packet was not heard. There are other possible reasons for non-receipt of the packet, but the MFJ-TNC 's response is based on the assumption of a collision.

After transmitting a packet, the MFJ-TNC waits a "reasonable" length of time (**FRACK**) for an acknowledgment. "Reasonable" is determined by the link

activity, frame length, whether the packet is being digipeated, and other time-related factors. If no ACK is received, the packet must be re-sent. If the unACKed frame was lost due to a collision, the assumption is that there is at least one other packet station out there that also lost a frame and will probably have exactly the same criterion for deciding when to retry the transmission as this station is using.

In order to avoid a second collision, the collision avoidance protocol calls for the stations retrying transmissions to wait a random time interval after hearing the frequency become clear before they key their transmitters. There must be enough different random wait times to provide a reasonable chance of two or more stations selecting different values. The difference between adjacent time values must be similar to the keyup time delay of typical stations on the frequency. This is the time lapse after a station keys its transmitter before other stations detect its presence on the channel, and is a function of the keying circuitry of the transmitter and the signal detection circuitry of the receiver. We have chosen the random time to be a multiple (0-15) of the transmitting station's keyup delay (**TXDELAY**). This is reasonable if one's own keyup delay is similar to that of other stations on the channel.

One other factor must be taken into consideration in optimizing data throughput. The currently implemented link protocols provide for relaying (digipeating) of packets. The acknowledgment procedure for such packets is that the relay station simply repeats packets without acknowledgment to the sending station. The receiving station sends its ACK back through the same digipeaters to the originating station. Since the digipeated packets are not acknowledged to the digipeater, an unsuccessful transmission must be retried from scratch by the originating station. In order to help alleviate the congestion of the frequency that tends to result when digipeated packets suffer collisions, the digipeater is given first shot at the frequency every time it becomes clear. Other stations, instead of transmitting as soon as they hear the channel clear, must wait a short time (**DWAIT**). This restriction applies to all stations except the digipeater, which is permitted to transmit relayed packets immediately. This prevents digipeated packets from suffering collisions except on transmission by the originating station.

A special time delay (**RESPTIME**) is used as the minimum wait time prior to transmitting acknowledgment frames, to prevent TNCs accepting data at high speed from the asynchronous port from colliding with acknowledgment frames when fewer than **MAXFRAME** packets are outstanding. The receiving TNC will wait long enough before sending the ACK so that it will hear the data packet

which would have caused the collision, thus avoiding a fairly frequent source of delay in versions of AX.25 prior to 2.0.

Channel Flow Control

Flow control of data through the link is determined by the rate at which data is being supplied to a sending TNC and accepted from a receiving TNC.

A TNC receiving data from the link will send an RNR when the next I frame successfully received will not fit into the buffer for output to the serial port.

Whenever a TNC transmitting data received from the serial port over the link runs out of temporary buffer space, the serial port will be halted by an XOFF character or CTS signal. In the MFJ-TNC implementation this happens whenever there are 7 packets built and less than 210 characters left in the buffer for input from the serial port.

When the TNC receiving data from the link clears out its buffers, it sends an RR to the transmitting TNC. In order to guard against the possibility of the RR being lost and the link becoming permanently locked, the transmitting TNC will periodically re-transmit the packet that provoked the RNR. The receiving TNC will continue to respond with RNR until it can accept the packet.

RADIO HOOKUP

MFGS. OR RADIOS	CONNECTOR TYPE	MIC. AUDIO To pin 1 of 1278	PTT To pin 3 of 1278	RX AUDIO To pin 4 of 1278	GROUND To pin 2 of 1278
KENWOOD	4 pin	pin 1	Pin 2	Speaker	Pin 3,4
"	5 pin	Pin 1	Pin 2	Speaker	Pin 4,5
"	6 pin	Pin 1	Pin 2	Speaker	Pin 6
"	8 Pin	Pin 1	Pin 2	Speaker	Pin 7,8
TR-2500	HTs	Tip-Lg.	Sleeve-Lg	Tip-Sm.	Sleeve-Sm
TR-x600	HTs	Ring-Lg.	Sleeve-Lg	Tip-Sm	Sleeve-Sm
TH-x1xx	"	"	"	"	"
TH-x15	"	"	"	"	"
TH-x5	"	"	"	"	"
ICOM	4 pin	Pin 1	Pin 2	Speaker	Pin 4
"	8 pin	Pin 1	Pin 5	Speaker or pin 8	Pin 6,7
"	HTs	Tip-Sm	Tip-Sm	Tip-Lg	Sleeves
YAESU	4 pin	Pin 2	Pin 3	Speaker	Pin 1
"	8 Pin	Pin 8	Pin 6	Speaker	Pin 7
FT-208	HTs	Pin 1	Pin 3	Pin 2	Pin 4
FT-x09	HTs*	Tip-Sm	Tip-Sm	Tip-Lg	Sleeves
FT-x3	HTs*	"	"	"	"
FT-727	HTs*	"	"	"	"

Table: A-1 HOOKUP FOR SPECIFIC RADIOS

*: Some ICOM and Yaesu HTs key the transmitter by completing the ground connection on the microphone. If your HT is one that is noted in the above chart, you must follow the instruction given in Chapter 3 of this instruction manual.

NOTE: The radio connection information listed in the above chart is believed to be accurate. However, you should CHECK the ACCURACY of this information with the **INSTRUCTION MANUAL** of your radio. MFJ Enterprises, Inc. is not responsible for any inaccuracy of information listed in the above chart.

MODEM CALIBRATION

The MFJ TNC is factory calibrated to operate to within factory guidelines. If it becomes necessary to re-calibrate the modem, then the following procedure is provided.

Modulator and Demodulator Frequency Calibration

Here we present two (2) Modulator and Demodulator calibration methods. Method I requires test equipment as noted, where Method II does not require test equipment.

Method I

HF Modem

Test equipment needed: Frequency Counter and probe and oscilloscope with probe.

1. Install push-on jumpers on JMP 4 and JMP 7.

2. Verify a push-on jumper is installed on JMP 8.

3. In the following procedure all frequencies are to be set to within +/- 2 HZ.

4. Place the frequency probe at JMP 9 pin 1. This is the top pin.

5. Place the oscilloscope probe on top pin of JMP 10.

6. Set dip switch #6 ON.

7. Set one of the dip switches 1 thru 5 to the Computer Baud Rate which appiles to the baud rate being used on the computer.

8. Push the **VHF/HF** switch to the **HF** position.

9. Initiate the calibration mode by typing:

   CALIBRATE <ENTER>

10. Now the modem must be keyed up. Do this by pressing the **K** key.

11. Check the voltage on pin 9 of U16. Press the **SPACE BAR** until this pin indicates -5 VDC.

12. Adjust R106 to where the frequency counter indicates 2125 Hz +/- 2 Hz.

13. Press the **SPACE BAR** until pin 9 of U16 indicates +5 VDC.

14. Adjust R105 to where the frequency counter indicates 2295 Hz,+/- 2 Hz.

15. Press the **D** key.

16. Locate R212, which is near the front of the PC board by the tuning indicator. Adjust R212 until the 10th led from the left is lit on the tuning indicator. This enables proper signal tuning within the HF bands.

VHF Modem

Test equipment needed: Frequency Counter and probe and oscilloscope with probe.

1. Install push-on jumpers on JMP 4 and JMP 7.

2. Verify a push-on jumper is installed on JMP 8.

3. In the following procedure all frequencies are to be set to within +/- 2 HZ.

4. Place the frequency probe at JMP 9 pin 1. This is the top pin.

5. Place the oscilloscope probe on top pin of JMP 10.

6. Set dip switch #7 ON.

7. Set one of the dip switches 1 thru 5 to the Computer Baud Rate which appiles to the baud rate being used on the computer.

8. Push the **VHF/HF** switch to the **VF** position.

9. Initiate the calibration mode by typing:

   CALIBRATE <ENTER>

10. Now the modem must be keyed up. Do this by pressing the **K** key.

11. Check the voltage on pin 9 of U16. Press the **SPACE BAR** until this pin indicates -5 VDC.

12. Adjust R78 to where the frequency counter indicates 1200 Hz +/- 2 Hz.

13. Press the **SPACE BAR** until pin 9 of U16 indicates +5 VDC.

14. Adjust R77 to where the frequency counter indicates 2200 Hz,+/- 2 Hz.

15. Press the **D** key.

16. Set the **TIME/DIV.** scale on the scope to **1 MS/DIV** and the **VOLT/DIV** scale to **5 V/DIV.** Connect the scope probe to the toppin of JMP 10.

17. Adjust R79 so that signal on the scope shows a 50% duty cyclesquare wave. The square wave should be uniform in width (i.e hightime is equal to the low time). The pulse duration of the high time and the low time is approximately 2.4ms. The CON and STA LEDS may blink simutaneously.

18. Type Q to quit the calibration routine.

METHOD II

The below procedure needs no test equipment, and is very accurate if done properly. Be sure to follow each step carefully. If any problems arise, please go back and check the preceeding step, to make sure it worked.

This procedure is a three (3) step process. The three steps areas follows:

1. Center the modulator tones over the required modem center frequency

   (Fc).

2. Align the demodulator center frequency.

3. Align the tuning indicator.

NOTE: ALL THREE STEPS SHOULD BE PERFORMED IN THE ABOVE ORDER!

If they are not all done at the same time, or in the correct order, the modem may not be receiving and transmitting on the same frequency, and the tuning indicator may give false indications.

The third step, alignment of the tuning indicator, should only be used in conjunction with alignment of the 300 baud 170 Hz shift demodulator.

The other AFSK modems available in the MFJ-TNC can be aligned using exactly the same steps presented here but substituting the appropriate part numbers for the adjustments. However, do NOT align the tuning indicator to anything but the 300 baud 170 Hz shift HF packet modem.

It is important that the tuning indicator alignment be optimized for the 300 baud 170 Hz shift HF packet modem. It will indicate correctly for all other modes when aligned for the HF packet modem.

As described elsewhere in this manual, the exact configuration of your radio's filters and whether it has IF shift or not will determine the exact required center frequency for the modem. Once the required center frequency has been determined, the modem calibration can be carried out.

NOTE: It is essential that the modulator tones be properly aligned FIRST as they will be used to align the demodulator center frequency.

Set the modulator tones to Fc MINUS 1/2 of the shift for the low tone and Fc PLUS 1/2 of the shift for the high tone. For the 170 Hz shift 300 baud modem used for HF packet this would be Fc + 100 Hz for the high tone and Fc - 100 Hz for the low tone.

Set Modulator Tones Using Built-in Calibration Software

1. Make sure that the modem and TNC are both configured for 170 Hz shift 300 baud operation.

2. Place a push on jumper at JMP 4 and JMP 7.

3. Verify push-on jumpers at JMP8 and JMP 9 pins 1&2.

4. Type "**CALSET** n <CR>". Where n is a number determined by:

   n = INT [525000 / F(low)] + 1

   This tells the CPU what tone frequency you are trying to achieve.

   A table of CALSET numbers to use for the various "standard" modem tone frequencies will be included at the end of this procedure.

5. Command the MFJ-TNC into calibrate mode by typing "CALI followed by a <CR>".

6. Command the MFJ-TNC to key the modem by typing "K".

7. Select the low tone by pressing the space bar until a voltmeter connected to U16, pin 9 reads - 5 volts.

8. Adjust R106 carefully until both the "CON" and "STA" LEDs on the front panel of the TNC are lit. One of the leds may filcker slightly. This is normal.

9. Type a "Q". This exits the MFJ-TNC from calibrate mode to ommand mode.

10. Type "CALSET n <CR>". Where n is a number determined by:

n = INT [525000 / F(high)] + 1

11. Command the MFJ-TNC into calibrate mode by typing "CAL <CR>".

12. Command the MFJ-TNC to key the modem by typing "K".

13. Select the high tone by pressing the space bar until a voltmeter connected to U16, pin 9 reads + 5 volts.

14. Adjust R105 carefully until both the "CON" and "STA" LEDs on the front panel of the MFJ-TNC are lit. One of the leds may flicker slightly. This is normal.

15. Type a "Q". This exits the MFJ-TNC from calibrate mode to command mode.

This completes the modulator tone alignment using the built in calibration facility. If you had any problems with this section, then DO NOT go beyond this point. If you do the calibration will be inaccurate. However, if all went well, then you may proceed.

Now that the modulator tones have been properly centered over the intended modem center frequency (Fc), now the demodulator center frequency will be aligned.

Demodulator Center Frequency Alignment

1. Place push on jumpers at JMP 4 and JMP 7, if they are not already in place.

2. Verify a jumper is at JMP 9 pins 1 and 2 and JMP 8.

3. Type CALSET . Where **n** is a number determined by the following equation:

n = INT (262,000 / f) +1

4. Command the MFJ TNC into calibration mode by typing **CAL** <ENTER

5. Command the MFJ TNC to key the modem by typing **K** <ENTER>

6. CAREFULLY adjust the appropriate control until the DCD LED on the front panel is fully illuminated. Please refer to Appendix page___for the proper control to adjust.

NOTE: The threshold control on the MFJ-TNC must be set to a position which will allow the DCD circuit to function properly. A setting approximately 1/3 to 1/2 of the total range starting from maximum CCW should be adequate.

Continue to VERY CAREFULLY adjust R113 until the STA and CON LEDs on the front panel either change state very slowly (alternate which one is lit) or until both are simultaneously illuminated.

NOTE: This is a very critical adjustment. It is very unlikely that you will be able to cause both LEDs to be turned on simultaneously, for longer than a very brief instant. Just fine tune R113 very carefully, and notice the action between the STA and CON leds. If they flash back and forth this is acceptable.

7. Return the MFJ-TNC to command mode by typing a "Q".

This completes demodulator center frequency alignment using the built in calibration software. If there were any problems in the preceeding procedure, then DO NOT go beyond this point. If you do the calibration will be inaccurate.

Now that the demodulator and modulator are properly aligned
to one another, the tuning indicator can be set for proper center indication.

Tuning Indicator Alignment

This procedure adjusts the tuning indicator so that it correctly indicates when a signal is properly tuned in relation to the demodulator center frequency. In order for the Tuning Indicator to be properly aligned the above calibration must be done properly, otherwise you will align the Tuning Indicator improperly.

NOTE: The tuning indicator should ONLY be adjusted in reference to the 300 baud 200 Hz shift modem used for HF packet and RTTY. If adjusted for this modem, It will indicate with sufficient accuracy for all other modes.

1. If you have not just finished aligning the modem as per the above instructions, do so now. Otherwise you may be aligning the tuning indicator to incorrect calibration settings.

2. Install push on jumpers at JMP 4 and JMP 7, if they are not still in place from the modem alignment procedure.

3. Ensure that the jumpers on JMP9 and JMP16 are placed as stated in the demodulator alignment section above.

4. Command the calibration routine to send 50 percent duty cycle square wave data from the modulator by typing "RXCAL" <CR>.

5. While observing the LEDs in the tuning indicator, adjust R212 in the tuning indicator area so that either the 10th or 11th led from the left (or both) are illuminated.

8. Return the MFJ-TNC to command mode by typing "Q".

9. Remove jumpers at JMP 4 and JMP 7.

This completes the tuning indicator alignment.

Now the modulator, demodulator, and tuning indicator are all aligned to the same center frequency. If you notice that on the air reports suggest that you are

transmitting and receiving on significantly different frequencies after successfully completing the above alignment procedure, it is possible that the radio needs realignment. Many different transceivers for HF are capable of being misaligned due to reference oscillator crystal aging or careless alignment by amounts exceeding 500 Hz. RIT inadvertently left on can also cause hard to detect problems in this area. Reliable HF packet communications requires that the frequency error presented to the demodulator be below 30 Hz. If several stations are to successfully share a single channel, transmitter / receiver offsets larger than this will be intolerable.

MFJ-TNC Adjustment Location Map

This is a map of the physical locations of the adjustment potentiometers on the MFJ-TNC circuit board. They are shown as they appear when looking down on top of the board with the board oriented so that the rear panel connectors are to the left. Information in the boxes is organized as shown below.

R78 VP L **1200 438**	VHF Low Tone Modulator
R77 VP H **2200 240**	VHF High Tone Modulator
R106 HP L **2125 247**	HF Low Tone Modulator
R105 HP H **2295 229**	HF High Tone Modulator
R79 VP **CALSET 8**	VHF Demodulator
R113 HP **CALSET 32**	HF Demodulator

NOTE: Separate procedure required to do alignment of CW demodulator center frequency.

NOTE: CW receive through a narrow filter for HF CW operation will require the CW demodulator center frequency to be selected to align with the radio's filter passband. MCW operation on VHF FM will require that both stations have both the modulator tone and demodulator center frequency to the same frequency.

Calset Values for Various Modulator Tone frequencies

Tone	CALSET #	Adjust	Modem / Remarks
2125	247	R106	HF Packet
			Fc = 2210 Hz
2295	229	R105	170 Hz shift
1300	404	R78	Packet / Fc = 1700 Hz, 800 Hz
			shift. CCITT V.23 std., preferable
			for HF 1200 baud, works
2100	250	R77	well on VHF FM too.
1200	438	R78	Packet / 1000 Hz shift standard. Too wide to fit comfortably
			through SSB filters for linear
2200	240	R77	mode 1200 baud use
2125	248	R106	Fc = 2550 Hz
2975	177	R105	850 Hz shift
2178	242	R106	Fc = 2220 Hz
2263	233	R105	85 Hz shift.

AUDIO OUTPUT CALIBRATION

The transmit audio output levels of MFJ-TNC Radio Port is factory set to 250 mV. You may find it necessary to set the output levels differently to match your radio specifications, then you should follow the procedure given in this appendix.

Transmit audio adjustment is accessible from the outside thru screw driver adjustment holes on the left side of the MFJ-TNC. It is not necessary to remove the cover.

Most often audio output level of the MFJ-TNC can be set simply by monitoring the transmitting audio with a connecting station. However, if you require a more precise setting or making the adjustment without an on-the-air test, then use the procedure given here.

Audio Output Level Adjustment Procedure

1. After the cmd: prompt sign, set the MFJ-TNC to VHF packet mode by setting S1 to the VHF (IN) position.

2. Set dip switch #7 on SW3 to the ON position. Set the correct terminal baud rate on SW3 according to the baud rate you are running on you computer or terminal. A list of terminal baud rates available is shown below:

DIP SWITCH #	BAUD RATE
1	300/19.2K
2	1200
3	2400
4	4800
5	9600

3. Place a push on jumper at JMP4 and JMP7.

4. Enter: **CALI** <CR> Press the "K" key. The PTT LED should illuminate.

5. Place the oscilloscope probe at JMP7.

6. Signal on the scope will be approximately 2.5 volts p-p.

7. Verify that the voltage on pin 9 of U16 is -5 Vdc. If it is +5 Vdc instead of -5 Vdc, push the space bar. The voltage should alternate between +5 Vdc and -5 Vdc each time the space bar is pressed. Set this point to -5 Vdc.

8. Move the probe to J9 pin 1 (TX audio). Adjust R157 for a signal of 100 mV p-p as shown on the scope. Or set it to a level recommended by your radio instruction manual.

9. Move the probe to J9 pin 4 (RX audio). The signal should be approximately 1 V p-p.

10. Press the space bar and again measure the peak to peak voltage at J9 pin 4.The audio level should not change.(Both mark and space audio should be at the same level.)

11. Remove the jumpers from JMP 4 and JMP7.

12. Switch SW1 to the OFF position.

HF RADIO ALIGNMENT

If you have determined that it is necessary to realign the MFJ-TNC modem center frequency to your radio filter center frequency, one of the following 2 methods should be used to make the radio filter center frequency (Fc) determination. Both methods require access to a frequency counter capable of measuring audio frequencies to a resolution of 1 Hz. Almost any frequency counter should be capable of this.

First method: NOISE AVERAGE FREQUENCY

This method also requires an active noise source like a receiver noise bridge. There are several suitable units available for this purpose.

1. Set the receiver to LSB mode with the 500 Hz filter selected.

2. Connect the noise source to the receiver input. Make sure there is no antenna connected to the system and that the receiver is tuned to a frequency which is free of coherent internally generated signals (birdies).

3. Set the noise source output for a reading of approximately S-9 on the receiver S meter.

4. Connect the counter to the receiver audio output

5. Adjust the receiver output level for enough audio to reliably trigger the counter.

6. Make sure the radio's IF shift control, if one is present, is in its proper position (centered or on detente).

7. Record the frequency indicated by the counter. The counter should indicate the average frequency of the noise spectrum passed by the filter in the receiver and translated to audio by the product detector. This will be the frequency used for the modem center frequency (Fc).

NOTE: If the counter is a phase locked loop (PLL) based prescaling type, its PLL may not lock properly to the noise signal. If this is the case, use method 2 below. If your counter can resolve 1 Hz with a counting gate time of less than 1 second, it is a PLL prescaling counter.

Second method: FILTER SKIRT AVERAGE FREQUENCY

1. Set the receiver to LSB mode with the 500 Hz filter selected.

2. Make sure the radio's IF shift control, if one is present, is in its proper position (centered or on detente).

3. Using either a signal generator or a stable, relatively strong carrier from an AM broadcast transmission (preferably ground wave signal), tune the receiver so that the carrier falls near the center of the filter passband. Choose a signal level near S-9 for this test. If your rig has a built in calibration oscillator, this is a good source for this signal.

4. Slowly and carefully tune the receiver so that the tone frequency is decreasing.

5. Find the point where the signal is reduced by 1 S-UNIT from the peak value reached near the center of the filter passband.

6. Measure this tone frequency with the counter. Record this value as F(low).

7. Slowly and carefully tune the receiver so that the tone frequency is increasing.

8. Find the point where the signal is reduced by 1 S-UNIT from the peak value reached near the center of the filter passband.

9. Measure this tone frequency with the counter. Record this value as F(high).

10. Calculate the required modem center frequency as:

Fc = [F(low)+F(high)]/2

Once the required center frequency has been determined, the modem calibration can be carried out.

NOTE: It is essential that the modulator tones be properly aligned FIRST as they will be used to align the demodulator center frequency.

Set the modulator tones to Fc MINUS 100 Hz for the low tone and Fc PLUS 100 Hz for the high tone using the procedure given in the owners manual. Align the demodulator to the modulator tones using the built in demodulator alignment facility invoked with the RXCAL command described Appendix B ofthismanual.

MFJ-TNC 2400 PACKET OPERATION

If your MFJ-TNC does not have the 2400 modem, an optional modem (MFJ-2400) can be purchased and installed. Installation is simple; your MFJ-TNC is equipped with all connectors necessary to make this installation without modification or soldering. If you have the MFJ-1270CT or the MFJ-1274CT the 2400 modem is already installed inside the unit.

With the 2400 modem installed, your MFJ-TNC is capable of operating 300, 1200 or 2400 baud packet. The 300 baud and 1200 baud packet modes are not affected by the installation of the 2400 modem.

The addition of the 2400 modem feature will in no way require any internal modification to your transceiver.

2400 Packet Operation Setup

All default parameters set for 1200 packet operation can be used for the 2400 operation. 2400 operation needs no unusual setup or parameter changes. There are however, some changes that can be made later to the MFJ-TNC parameters which will enable you to improve the speed of the throughput performance of the 2400 operation. The "honing" of the parameters may not seem like much, but we have found that at 2400, the MFJ-TNC seems to be more responsive to the TXDELAY, DWAIT, RESPONSE and SLOTTIMES. When using direct connects and good paths, the MAXFRAME and PACLEN commands can be increased to allow larger packets to be moved during each transmission. When returning to the active thru-put frequencies, these two commands should be reduced to their original settings. You may find that if you were using a TXD of 50, then a TXD of 40 will now perform better. The DWAIT can be shortened or lengthened to suit the AGC recovery time of your radio. For instance, if you have been running the DWAIT of 16, it may now perform better at DWAIT of 12 or even 10. The FRACK will appear to exercise more at 2400.

2400 really shows its place in the packet world when used to pass large ASCII, BINARY and PICTURE files. It is always good to use clear frequency and/or use direct connects to the target station rather than going thru a node or digipeater. The reason is obvious. There are few 2400 nodes at the present time. However, it should be pointed out that implementation of a 2400 node is just as easy as building and using a 1200 node.

To select 2400 baud packet operation, set dip switch #8 ON at SW3.
The dip swiches 6 ,7, and 8 on SW3 will set as follows for 2400 baud operation:

6	**7**	**8**
OFF	**OFF**	**ON**

The MFJ-TNC will be set to 2400 packet operation. The **TURBO** LED will light. Note that if your MFJ- TNC is not equipped with the 2400 modem, the **TURBO** LED will not function and you will not be able to operate 2400 packet.

B. Receive Audio Setting

The MFJ 2400 modem employs automatic gain control (AGC) for its receive audio. The receive audio level is pre-set for proper 2400 operation; no adjustment is necessary in most cases. If you set the receive audio of your radio properly for 1200 operation, then it will be suitable for the 2400 operation also. No adjustment for the receiver audio on the 2400 modem board is needed.

C. Transmit Audio Setting

Transmit audio on the 2400 board is set by adjusting R38 (next to T2) on the 2400 modem board. Transmit audio for the 1278BT is pre-set at the factory to match the audio level of the 1200 modem on the MFJ-TNC mother board. Once the 1200 and the 2400 transmit audio are set to the same level, then you may adjust the audio level going into your radio by using the "Transmit Audio" controls on the left side of the MFJ-TNC. Note that these controls set the transmit audio levels for all the operation modes of the MFJ-TNC , including the 2400 packet operation.

When adjusting the transmit audio level please note that the range of R38 on the 2400 board is pre-set by CN-6 header. The shorting jumper on CN-6 header sets range as follows:

CN-6 Jumper Position	**Transmit Audio Range (no load)**
no jumper	50 mV - 60 mV p-p
1 & 2 (default)	100 mV - 200 mV p-p
2 & 3	250 mV - 3 V p-p

JUMPER FUNCTIONS AND LOCATIONS

The MFJ-TNC mother board has many jumper connectors. Each jumper connector has a special function. The Jumper Function chart in this appendix will help in identifying each jumper function. Figure G-1 will help in locating the jumper connectors easily.

For normal operation a shorting jumper must be placed on the following connectors: JMP 5; JMP 8; JMP 9 pins 2,3; JMP 13; JMP 18 pins 1,2; JMP 15 pins 2,3; JMP 26 pins 1,2. Also on the modem disconnect header J4 the following pins need jumpers pins 1,2 11,12 13,14 17,18.

Table G-1: Jumper Function

Jumper #	Position	Function
JMP1	Pin 1 & 2	!DCD (RS-232C) stays on
	Pin 2 & 3	!DCD (RS-232C) stays off
	OFF (default)	!DCD reflects connect status
JMP2	Pin 1 & 2 (default)	4.92 MHz CPU clock
	Pin 2 & 3	2.46 MHz CPU clock
JMP4	ON	disable Tx watch-dog
	OFF (default)	enable Tx watch-dog
JMP5	ON (default)	Lithium battery connected
	OFF	Lithium battery disconnected
JMP7	ON	analog loopback mode
	OFF (default)	normal modem operation
JMP8	ON (default)	demodulator enabled
	OFF	demodulator calibrate
JMP9	Pin 1 & 2	calibrate U16 tones
	Pin 2 & 3 (default)	normal modem operation
JMP10	ON	digital loopback mode
	OFF (default)	normal modem operation
JMP11	LEFT	transmit data NRZ NEED PIN #
	RIGHT (default)	transmit data NRZI
JMP13	ON (default)	TTL, RTS enable
	OFF	TTL, RTS disable
JMP15	Pin 1 & 2 (default)	256K firmware EPROM
	Pin 2&3	512K bit firmware EPROM

Table G-1: Jumper Functions (Cont.)

Jumper#	Position	Function
JMP17	Pin1&2	2400 baud ext. modem clock
	Pin 2 & 3(default)	9600 baud ext. modem clock
JMP18	Pin 1 & 2(default)	Enable 19.2K baud termial
		Disable 300 baud terminal
	Pin 2 & 3	Enable 300 baud termial
		Disable 19.2K baud terminal
JMP19	Outside pair(default)	Enable 32K mailbox RAM
	Middle pair	Enable 128K mailbox RAM
	Inside pair	Enable 512K mailbox RAM
JMP20	ON	512K mailbox RAM installed
	OFF(default)	32K or 128K mailbox RAM
JMP23*	ON	Enable memory RESET
	OFF	(default) Normal operation
JMP26**	Pin 1&2 (default)	Normal +5Vb bbRAM operation
	Pin 2&3	Real-time clock installed
JMP27	Pins 1&2 (Default)	Normal SW3 Operation
	Pins 2&3	Baud Rate Switch SW3 Bypass
JMPJ	ON	TX audio has flat response
	OFF(default)	TX audio 6db/oct pre-emphasized
JMPL	ON OFF(default)	TX audio loopback to PTT for Radio Port J9
JMPR	ON OFF(default)	Analog audio loopback for Radio Port J9
JMPX	ON(default)	Speaker Transmit Tone Enable
	OFF	SpeakerTransmit Tone Disable
JMPY	ON(default)	Speaker Receive Tone Enable
	OFF	Speaker Receive Tone Disable
JMPZ	ON(default)	Speaker Connect Tone Enable
	OFF	Speaker Connect Tone Disable

* When JMP23 is shorted, it will **RESET** the MFJ-TNC. This means that all parameters will be reset to the default values. This is the same as removing the bbRAM battery except it is much quicker. **DO NOT SHORT THIS JUMPER MORE THAN A COUPLE OF SECONDS, OTHERWISE BATTERY DAMAGE COULD RESULT!!**

** MFJ offers an optional Real-time clock module (MFJ-43) that can be installed on the MFJ-TNC mother board. This clock keep the MFJ-TNC clock running all the time. You will not have to reset the clock everytime you turn the MFJ-TNC on.

Fig. G-1: Jumper Connector Location

COMMAND SUMMARY

Command	Parameter	Default	Mode	Function	Page
8BITCONV	ON|OFF	on	Packet	Enables transmission of 8 bit data in converse mode	6-5
ABORT	--	I-command	M-Packet	Allows SYSOP to force a disconnect on the Mailbox link	6-6
ACKPRIORITY	ON|OFF	on	Packet	Permits an acknowledging TNC to transmit without regard to slotting delay	6-7
ACKTIME	n	14	Packet	Controls a delay that occurs whenever any packets that have been received are not addressed to that unit	6-7
ANSWRQRA	ON|OFF	on	Packet	Set MFJ TNC to polls all TNCswithin range.	6-9
AUTOLF	ON|OFF	on	Packet	Determines the way the <CR>characters are displayed.	6-13
AWLEN	n	8	All	Defines the word length used by the MFJ TNC 's RS-232 port.	6-14
AX25L2V2	ON|OFF	on	Packet	Determines the use of AX.25 Level 2 Ver. 2 or Ver. 1 Protocol.	6-15
AXDELAY	n	0	Packet	Sets the voice repeater keyup delay in 10 ms intervals.	6-16
AXHANG	n	0	Packet	Sets the voice repeater hang time in 100 ms intervals.	6-17
BBSMSGS	ON|OFF	off	Packet	Controls the display of certain messages incommand and CONVERS mode	6-18
BEACON	n	0	Packet	Sets the timing for an automatic transmission of a packet.	6-19
BKONDEL	ON|OFF	on	Packet	Determines the way the screen is updated when a character is deleted in the command mode.	6-20
BLP	ON|OFF	on	Packet	Allows Host Mode operation	6-21
BTEXT	text	blank	Packet	Specifies the text of the beacon packet.	6-22
BUDLIST	ON|OFF	off	Packet	Determines if the packets listed in LCALLS are to be displayed.	6-23
CALIBRA	--	I command	All	Used to transfer the control to the modem calibration routine.	6-24
CANLINE	n	$18 (^x)	Packet	Changes the cancel-line input editing command character.	6-26
CANPAC	n	$19 (^Y)	Packet	Changes the cancel-packet inputediting command character.	6-27
CBELL	ON|OFF	off	Packet	Sends bell tone to computer or terminal speaker when a packet connection is made.	6-28
CHAT	--	I-command	M-Packet	Allows SYSOP to break onto the mailbox's connected link.	6-29
CHECK	n	30	Packet	Sets a connection timeout.	6-29
CHECKV1	ON|OFF	off	Packet	Enables the automatic idle-link-dis- connect feature for AX.25 L2V1 connections.	6-30
CONPERM	ON|OFF	off	Packet	Allows a connection to become 6-30 permanent.	
CMDTIME	n	1	Packet	Sets the transparent mode timeout value.	6-31
CMSG	ON|OFF	off	Packet	Enable a message to be transmitted whenever there is a connection made.	6-32
CMSGDISC	ON|OFF	off	Packet	Controls whether the MFJ TNC will initiate a disconnect sequence after it is connected to.	6-32
COMMAND	n	$03 (^C)	All	Sets the character used to enter the command mode from CONVERS mode.	6-33
CONMODE	C|T	C	Packet	Sets the MFJ TNC to enter the transparent mode or converse mode automatically.	6-34
CONNECT	C1|Cx	none	Packet	Issues a connect from the command mode to another packet station.	6-35
CONOK	ON|OFF	on	Packet	Determines the action taken by the MFJ TNC when it receives a connect request.	6-36
CONSTAMP	ON|OFF		off	PacketEnables the time stamping when a disconnect occurs.	6-37
CONVERS	--	I-command	All	Forces the MFJ TNC to enter the converse mode.	6-37
CPACTIME	ON|OFF	off	Packet	Enables the automatic transmission of packets in the converse mode.	6-38
CR	ON|OFF	on	Packet	Causes the MFJ TNC to send a <CR>every time a new line character is sent.	6-39
CTEXT	text	blank	Packet	Determines the packet text to be sent when a connect is made.	6-40
CSTATUS	--	I-command	Packet	Shows streams identifier and link state of all streams.	6-39
DAYTIME	D/T	none	Packet	Sets the time and date used by the MFJ TNC	6-43

COMMAND	PARAMETER	DEFAULT	MODE	FUNCTION	PAGE
DAYUSA	ON|OFF	on	Packet	Determines the display format for the time and date.	6-44
DEADTIME	nnn	33(330Ms)	Packet	Determines the basic time interval used by the slotting procedure.	6-45
DELETE	ON|OFF	off	Packet	Changes the input editing command.	6-46
DEFLTDLC	0-254	254	Host	Sets default DLC number for Host Mode	6-47
DIGIPEAT	ON|OFF	on	Packet	Allows your station to be used as a digipeater	6-48
DISCONNE	--	I-command	Packet	Used to disconnect a connected station in packet	6-49
DISPLAY.	--	class	Packet	Used to list all the commands the MFJ TNC acknowledges	6-50
DWAIT	n	33	Packet	Used to avoid collisions with digipeating	6-53
ECHO	ON|OFF	on	All	Allows the MFJ TNC to transmit back to you everything that you type in all mode of operation.	6-55
ESCAPE	ON|OFF	off	Packet	Specifies the character which will be output when an <escape> character is to be sent	6-56
FIRMRNR	ON|OFF	on	Packet	Controls the handling of busy states by MFJ TNC.	6-58
FLOW	ON|OFF	on	Packet	Sets type-in flow control to the terminal	6-59
FORWARD	--	I-command	Packet Mailbox	Mail forwading to the destination bbs.	6-59
FRACK	n	3	Packet	Sets the time interval between retries.	6-60
FULLDUP	ON|OFF	off	Packet	Allows communication in full duplex.	6-60
HEADERLN	ON|OFF	off	Packet	Affects the display format of monitored packets.	6-61
HEALLED	ON|OFF	off	Packet	Redefines the function of the STA and CON LEDs.	6-62
HID	ON|OFF	off	Packet	Controls the sending of identification packets by the MFJ TNC.	6-62
ID	--	I-command	Packet	Sends a special identification packet to be sent in packet.	6-63
KILONFWD	ON|OFF	off	M-Packet	Determines whether or not the MFJ TNC deletes a message after it has been forwarded.	6-63
KISS	ON|OFF	off	Packet	Allows the MFJ TNC to works as a modem for special programs such as TCP/IP.	6-64
LCALLS	call	none	Packet	Used in conjunction with BUDLIST, allows selective monitoring of other packets.	6-65

COMMAND	PARAMETER	DEFAULT	MODE	FUNCTION	PAGE
LCSTREAM	ON|OFF	on	Packet	Allows MFJ TNC to understand lower case characters as upper case after the streamswitch is entered.	6-65
LCOK	ON|OFF	on	packet	Determines whether the lower or upper case characters are set.	6-66
LFADD	ON|OFF	off	packet	Enables the MFJ TNC to go to the next line when a <CR> character is received.	6-66
LFIGNORE	ON|OFF	off	Packet	Line feeds are ignored except in transparent mode.	6-67
MAILBOX	ON|OFF	on	Packet	Enables the personal mailbox.	6-68
MAILLED	ON|OFF	on	Packet	Controls the STA/MAIL LED. Flashes when mail is presence.	6-69
MALL	ON|OFF	on	Packet	Determines the class of packets which are monitored.	6-70
MAXFRAME	n	4	Packet	Sets the upper limit for the outstanding packets that can occur at one time.	6-72
MCOM	ON|OFF	off	Packet	Enables monitoring of connected and disconnected packet when monitor is on.	6-73
MCON	ON|OFF	off	Packet	Allows the monitoring of otherpackets while connected to another station	6-74
MCTEXT	text	blank	Packet	Allows storing of text (messages) to be stored for mailbox. Text is sent when mailbox is connected	6-74
MFILTER	n1-n4	$00	M-Packet	Allows you to eliminate certain characters from received packets.	6-75
MHCLEAR	--	I-command	Packet	Clears the MHEARD list.	6-76
MHEARD	--	I-command	Packet	A list of all packet monitored.	6-76
MYDLCNUM	0-254	0	Host	Sets the DLC number for Host Mode	6-76
MNONAX25	ON|OFF	off	Packet	Allows MFJ TNC to monitor non AX.25 packet.	6-77
MNONPRIN	ON|OFF	on	Packet	Determines whether monitored packets containing non-printable characters are monitored or discarded	6-77
MONITOR	ON|OFF	on	Packet	Enables packets that are not6-78 addressed to you to be displayed.	
MRPT	ON|OFF	on	Packet	Affects the way monitored packets are displayed.	6-79
MSTAMP	ON|OFF	off	Packet	Enables the time stamping of monitored packets	6-80
MTIMEOUT	0-250	30	M-Packet	Mailbox connect will timeout after a time set by this command.	6-80
MYCALL	call	nocall	Packet	Sets the callsign of the MFJ TNC	6-82
MYALIAS	call-n	blank	Packet	Specifies an alternate callsign for use as a digipeater only.	6-82
MYHIERAD	nnnn	text	M-Packet	Sets the heiarcal address text sent by a Mailbox forward.	6-83
MYMCALL	call	nocall	M-Packet	Dedicated mailbox callsign.	6-83
NEWMODE	ON|OFF	off	Packet	Selects the way the MFJ TNC behaves when connections are made and broken.	6-86
NODEFORW	--	I-command	M-Packet	Similar to Forward command but with callsign+ up to 8 vias.	6-87
NODEPATH	--	I-command	M-Packet	Commands connected node by Nodeflow to link with the receiving BBS.	6-87
NOMODE	ON|OFF	off	Packet	Determines if the MFJ TNC will switch manually or automatically to command mode.	6-88
NUCR	ON|OFF	off	Packet	Causes transmission of <null> characters, producing a delay following any <cr> sent to the terminal.	6-88
NULF	ON|OFF	off	Packet	Same as NUCR, instead of <cr> it sends a delay after a <lf>.	6-89
NULLS	n	0	Packet	Used in conjunction with NUCR and NULF, and specifies how many <null> characters are sent.	6-89
PACLEN	n	128	Packet	Determines the number of characters it takes to automatically transmit a packet.	6-90
PACTIME	n	10	Packet	Determines the length of time between transmit and receive.	6-91
PARITY	n	0	Packet	Sets the parity mode for terminal or computer data transfer.	6-91

Commands	Parameters	Default	Mode	Function	Page
PASS	n	$16 (^V)	Packet	Selects the ASCII character used for the "pass" input editing character.	6-92
PASSALL	ON|OFF	off	Packet	Causes the MFJ TNC to display packets received with invalid CRC fields.	6-93
RECONNECT	call 1-9	I-command	Packet	Used to change the path through which you are currently connected to a station.	6-100
REMSYSOP	call0-15	blank	M-Packet	Permits the SYSOP to perform sysop functions remotely.	6-101
RESTART	--	I-command	Packet	Re-initializes the MFJ TNC using the stored parameters.	6-101
REDISPLA	n	$12 (^R)	All	Used to change the redisplay-line input editing character.	6-101
RESET	--	I-command	All	Resets all parameters to their default values and reinitiates the unit.	6-102
RESPTIME	n	0	Packet	Sets the minimum delay that is imposed on any acknowledging packets.	6-103
RETRY	n	10	Packet	Allows retransmission of frames that are not acknowledged.	6-103
REVFLIM	call-n	blank	M-Packet	Callsigns of BBS to enable reverse-forwards.	6-104
RXBLOCK	ON|OFF	off	Packet	Determines whether the information will be sent in standard or block format.	6-105
RXCAL	--	I-command	All	Generates test signals that are used by the internal tuning software to align the demodulator circuit.	6-107
RVFALWAY	ON|OFF	on	M-Packet	Initiates forwards and reverse of all forwardable messages	6-109
SCREENLN	n	0	All	Used to properly format terminal output.	6-109
SENDPAC	n	$0D (CR)	Packet	Selects the character that will force a packet to be sent in CONVERSE mode	6-110
SLOTS	nn	3	Packet	Determines how many sides are on the slot time dice.	6-112
START	n	$11 (^Q)	All	Selects the user restart character	6-114
STOP	n	$13 (^S)	All	Selects the user stop character.	6-115
STREAMCA	ON|OFF	off	Packet	Used to enable the display of the connected to station after the stream identifier.	6-116
STREAMDB	ON|OFF	off	Packet	Used to display received STREAMSWITCH characters by "doubling" them	6-117
STREAMSW	n	$7C (|)	Packet	Selects the character used by both the MFJ TNC and the user to select a new "stream".	6-118
SYSOP	--	I-command	Packet	Enables the MAILBOX systems operator to enter in messages to the BBS system/bbs.	6-118
TIMEDCMD	text	blank	M-Packet	Text string in this command is executed at a time pre-set by Timedmin command.	6-118
TIMEDMIN	n	60	M-Packet	Set the time for Timedcmd command.	6-119
TRACE	ON|OFF	off	Packet	Enables the debugging protocol function.	6-120
TRANS	--	I-command	Packet	Transparent mode.	6-121
TRFLOW	ON|OFF	off	Packet	Enables and disables the software flow control.	6-121
TRIES	n	none	Packet	Retrieves the count of "tries" on the currently selected input stream.	6-122
TXDIDDLE	ON|OFF	off	Packet	Invokes efficient key up technique in transmitted packet to increase throughput.	6-125
TXDELAY	n	33	Packet	Tells the MFJ TNC how long to wait after keying up the transmitter before sending data.	6-127
TXDELAYC	n	2	Packet	Controls a new timer that runs after the regular TXDELAY time has expired	6-128
TXFLOW	ON|OFF	off	All	Enables the software flow control for the transparent mode.	6-129
TXTMO	n (0-65535)	0	Packet	A health counter that registers the number of packet timeout/recovery events that have occurred sine the MFJ TNC was powered up	6-129

Commands	Parameters	Default	Mode	Function	Page
TXUIFRAME	ON|OFF	on	Packet	Used to tell the MFJ TNC what to do with the unconnected information left in its buffer.	6-130
UNPROTO	call1	CQ	Packet	Sets the digipeat and destination address fields of packets sent in the unconnected mode.	6-130
USERS	n	1	Packet	Controls the manner in which the incoming connect requests are handled	6-131
XFLOW	ON|OFF	on	All	Enables the flow control.	6-133
XMITOK	ON|OFF	on	Packet	Enables the transmit function.	6-134
XOFF	n	$13 (^S)	All	Selects the MFJ TNC stop character	6-134
XON	n	$11 (^Q)	All	Selects the MFJ TNC restart character.	6-135